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To whom it may concern:

The enclosed report is being submitted for your consideration with respect to the *Winter Use Plans Supplemental Draft Environmental Impact Statement for the Yellowstone and Grand Teton National Parks And John D. Rockefeller, Jr., Memorial Parkway.* It presents the findings of a study of air quality associated with snowmobile use in Yellowstone N.P. during February 13-16th, 2002, and contains conclusions reached regarding snowmobile use levels, types, and impacts on air quality in the Park.

Respectfully,

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SPATIAL VARIATION AND CHARACTERISTICS OF VOLATILE ORGANIC COMPOUNDS ASSOCIATED WITH SNOWMOBILE EMISSIONS IN YELLOWSTONE NATIONAL PARK

A Preliminary Research Report Submitted to the National Park Service, United States Department of the Interior

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Abstract

Preliminary results of a spatial investigation of emissions associated with oversnow travel in Yellowstone National Park on February 13 and 16, 2002, are presented. The National Park Service is currently engaged in the task of developing regulations for improving air quality in Yellowstone National Park with the primary intentions of reducing human exposure to toxic air pollutants and improving visibility. While the NPS is drawing upon the results of an extensive body of research, to date, no previous investigation has focused specifically on the issue of the spatial variability of snowmobile emissions. Ninety-six whole air samples whose locations were georeferenced using global positioning system receivers/data loggers were analyzed using gas chromatography with flame ionization and electron capture to determine the mixing ratios of some 95 volatile organic compounds. Utilizing a geographic information system to show the extent of oversnow vehicle emissions in Yellowstone National Park, the findings indicate that two-stroke snowmobile engines appear to contribute large quantities of hydrocarbons, including air toxics, to the airshed.

1. Introduction

This report summarizes the findings of an intensive study of the spatial distribution of volatile organic compounds (VOCs) associated with oversnow vehicular travel in Yellowstone National Park (YNP) during February, 2002[1]. The report constitutes a set of preliminary findings and is being submitted for consideration by the National Park Service (NPS) in its capacity as lead agency in the development of winter use plans for the Yellowstone and Grand Teton National Parks, and the John D. Rockefeller, Jr., Memorial Parkway, as required by settlement agreements[2] established with litigants in 1997 and 2001. The investigators have the fullest confidence in the findings reported, and the preliminary nature of the report owes to consideration of a more limited set of VOCs than were resolved in the laboratory. The investigators intend to submit a more comprehensive set of findings in the future in the form of either an additional report or a draft manuscript to be submitted for publication in a peer-reviewed scientific journal.

1.1 Overview of Investigation

As described in the research proposal submitted for approval by the YNP Research Permit Office, the investigators acquired whole air samples for analysis throughout the Park on February 13 and 16, 2002. The dates selected (Wednesday and Friday, respectively) were selected to coincide with both lower- and higher-traffic days associated with the President's Day Weekend which has historically represented a high-visitation period during the Park's winter season [*J. Sacklin*, Personal Communication,

[1] YNP investigation: "Spatial variation and characteristics of volatile organic compounds associated with snowmobile emissions in Yellowstone National Park" (YNP Research Permit No. 5266).

[2] These settlement agreements led to the development of a Final Environmental Impact Statement (10/10/2000) and associated Record of Decision (11/22/2000) and Final Rule (1/22/2001), and Supplemental Environmental Impact Statement (In Review, 3/29/2002).

2001]. A total of ninety-six whole air samples were acquired in evacuated steel canisters. They were distributed among morning, afternoon, and diurnal sample sets acquired for each day. The locations of the samples were registered with global positioning system (GPS) units, and their contents analyzed by gas chromatography using flame ionization and electron capture detection. In addition, exhaust emissions from both a two-stroke and a four-stroke snowmobile were sampled for comparative purposes as well as gasoline vended at the Old Faithful concession and at commercial vendors in the towns of West Yellowstone, Gardiner and Livingston, MT. The data were subjected to spatial analysis utilizing interactive graphical interpretation and mapping conducted with the use of a geographic information system (GIS). Discussions of the methodologies employed in the field and laboratory, the field conditions associated with data collection, the chemical and spatial analyses undertaken, and of our findings are presented.

1.2 Air Quality Issues in Yellowstone National Park, Previous Research, and Rationale for the Investigation

This investigation was undertaken to investigate the spatial distribution of VOCs associated with oversnow vehicular travel in YNP. Like other U. S. National Parks, YNP has been designated a mandatory Class I Airshed under the Clean Air Act (CAA), and is thus subject to the requirement that the quality of air within its boundaries remain in a pristine or high-quality state such that it does not suffer from impairment of visibility [*Clean Air Act - Section 169A.a.1*, 1970, 1990]. Owing to a steady increase in wintertime oversnow recreational vehicle use in the Park since the late 1960s, which has significantly increased mobile-source (i.e., snowcoach and especially snowmobile) emissions, air quality and visibility within the Park have been acknowledged to have decreased to levels that have prompted Park Managers to consider alternative regulatory strategies [*National Park Service*, 1999, 2000a, 2000b]. In response to the need to remedy impairment of visibility in the Park resulting from manmade air pollution as required by the CAA (Section 169A.a.1) and to address the issue of human exposure to toxic air pollutants, also mandated by the CAA and by the Occupational Safety and Health Administration (OSHA), extensive research has been conducted within the Park to characterize and quantify snowmobile emissions with respect to carbon monoxide, VOCs, and particulate matter emissions as well as their impacts on human health [*National Park Service*, 1995, 1996; *Ingersoll et al.*, 1997; *Snook and Davis*, 1997; *Radke*, 1997; *Carrol and White*, 1999; *Ingersoll*, 1999; *Kado et al.*, 1999; *Morris et al.*, 1999; *Institute for Environment and Natural Resources*, 2000; *Bishop et al.*, 2001].

While this body of research is broad in scope, the majority of work has been focused on the issue of human exposure to toxic air pollutants (i.e., VOCs and particulate matter). No study to date has explicitly documented the spatial distribution of emissions associated with oversnow travel in the Park. Furthermore, no study other than those reported by *Ingersoll et al.* [1997] and *Ingersoll* [1999] relied on more than 6 sample sites within the Park itself. The spatial variation of snowmobile emissions related VOCs remains unknown to date [*Institute for Environment and Natural Resources*, 2000].

Based on the results of this body of research and additional studies concerning snowmobile-wildlife interaction, the National Park Service (NPS) published a Record of Decision (ROD) based on a "Winter Plans Final Environmental Impact Statement..." [2000a] which would have steadily reduced snowmobile use in the Park over the period 2001-2003 and encouraged winter visitation only via NPS-managed snowcoaches. However, the NPS has since been forced to set aside its ROD and develop additional or modified alternative courses of action for regulating oversnow travel in the Park in a Supplemental Environmental Impact Statement [*U.S. Dept. of Interior*, 2002].

Given this state of affairs, the investigators conducted a rigorous investigation of the spatial variation of snowmobile related VOCs in YNP under conditions of historically high levels of snowmobile usage. The intent of the investigation was to establish a set of baseline data associated with levels of oversnow travel that approximate historical peaks in order to document, through future studies, the effectiveness of any reduction in such travel owing to management decisions enacted by the NPS. Additionally, the investigation was intended to serve as a pilot-study designed to test the sampling and analytical methodologies for utilization in future studies to be conducted in the Park.

2. Methods

The methods involved in the acquisition and analysis of air samples, and in the spatial analysis of results are presented here.

2.1 Study Area, Sample Collection, and Field Conditions

A regular grid of 20 km^2 cells was superimposed over the Park to identify potential sample sites that correspond to wintertime accessible areas and to ensure complete spatial coverage (Figure 1). In addition to those samples obtained within the Park's boundaries, samples were also acquired at Silver Gate, the East Entrance, and to the south of West Yellowstone adjacent to the Park boundary (Table 1). These three sites were selected, respectively, to provide information concerning the potential for drift of VOCs under conditions associated with dominant westerly flow of air masses over the Park.

Samples were acquired in the early morning (AM) and again in the early afternoon (PM) at each sample site on February 13 and 16 (Wednesday and Saturday, respectively), 2002, to assess the relative impact of oversnow travel on VOC distributions within the Park. These dates were selected for sampling activity in order to develop a comparison of the spatial variability of VOCs associated with low-to-moderate and high visitation levels. Historically, the month of February is known for high wintertime visitation levels. In February, 1996, average daily visitation was in the range of 1,500 – 1,800 persons [*National Park Service*, 1999], and NPS documents consistently indicate that the vast majority of wintertime daily visitation is represented by snowmobile trips [*National Park Service*, 1999; 2000a; 2000b]. Furthermore, personal communication with YNP Planning Staff indicated that the President's Day weekend has historically constituted a high visitation period [*J. Sacklin*, Personal Communication, 2001].

Although NPS visitation data for the sample dates were not available to the investigators at the time of this report, unconfirmed data that were probably derived from official YNP data indicate that some 1,200 snowmobiles entered the West Entrance on Saturday, February 16, 2002 [*Greater Yellowstone Coalition*, 2002].

Within each daily sample period, samples were acquired within a three-hour period of time. Additionally, a complete set of diurnal samples was acquired every second hour for each day beginning at 12:00 a.m. and ending at 11:59 p.m. at the Lake Ranger Station. This site was selected over the Old Faithful Lodge site in order to better assess VOC dynamics in well mixed air at a more remote location in the Park. Diurnal data corresponding to the AM and PM sample periods on each day were added to their respective data pools.

Ninety-six whole air samples were collected in 1-liter silica lined canisters (Entech Instruments, Simi Valley, CA) and 2-liter electropolished stainless steel canisters (University of California, Irvine, CA). The morning sample collection periods began on at 5 a.m. prior to the initiation of significant oversnow travel and solar loading which can influence the photochemical processing of atmospheric trace gases. Afternoon sampling began approximately at solar noon and extended over a 2-3 hour period of time after which significant oversnow travel had occurred. Due to the apportionment of 2-4 sample sites per field sampler, each sample route or course required a maximum period of 3 hours to complete. The protocol for the collection of well mixed whole air sample for trace gas analysis was strictly followed by each field sampler. All samples were to be collected following a period of several minutes after the shutdown of any research vehicle and at a distance of 50+ m from upwind of all local vehicles and transportation routes. In conjunction with the acquisition of the air samples, data concerning site and canister coding, date and time, topography, wind speed, and ground surface cover were recorded in the Trimble GPS units for each site. In addition, the use of Lowrance® GlobalMap100 GPS units permitted the acquisition of supplementary location data which were manually recorded on data forms together with the basic site data for backup purposes.

In order to compare the relative emissions from two-stroke and four-stroke snowmobiles representative of the rental fleet utilized within the Park, tailpipe exhaust samples were collected from two of the five snowmobiles employed in the field by the research team. Both machines were rented from a commercial snowmobile outfitter located in West Yellowstone, Montana, for the duration of the study period. The sampling methods and analyses for exhaust samples are fully described in Section 3.1 of this report.

The week bracketing the field sampling was dominated by high pressure in YNP. Weak cold fronts passed through the region prior to each sample day bringing clean air from the northwest and scattered dustings of snow. During each day on which samples were collected air was vertically stable with inversions developing during the nighttime hours and lasting well into the short daylight period. Through the period 12:00 a.m. on Wednesday, February 13, to 11:59 p.m. on Saturday, February 16, surface temperatures ranged from -33 °C (-28 °F) to approximately 0 °C (32 °F) (Table 2). Meteorological observations recorded on Saturday, February 16, at Ranger Stations located within the Park and at the NWS weather station located near the Lake Ranger Station indicated that a slight warming of surface temperatures associated with clear skies produced an increase in elevation of the boundary layer height. However, on neither day was the inversion suspected to have broken. During each day, strong temperature increases of 5-8 °C were noted from hillslope transects. Surface winds were calm or light with mainly a southerly component through the study period, but assumed more of a westerly component as the high-pressure system moved to the southwest. Most collection sites recorded calm conditions or winds of less than 2 miles per hour (1m/sec). Maximum velocities were recorded in gusts at less than 17 miles per hour (8 m/sec) from February 13-16.

Ground surface conditions were characterized by snow cover at all but one site. Snow depths ranged from 48 inches (125 cm) at Grant Village to patchy cover at Mammoth. On Saturday, February 16, the West Entrance recorded a snow depth of 30 inches (76 cm) and 24 inches (51 cm) were recorded at Old Faithful. Due to the low temperatures and limited air exchange, minimal loss of snow cover occurred during the week through either sublimation or melt.

2.2 Trace Gas Analysis

Nonmethane hydrocarbons (NMHCs) and selected halocarbons were measured from the collected whole air samples. The samples were analyzed by trapping 650.0 cm^3 (STP) of air on a sample concentration loop, a 1/4-inch O.D. stainless steel loop filled with 1 mm diameter glass beads, immersed in liquid nitrogen. The total volume sampled was measured by pressure difference using a capacitance manometer. After the sample was trapped, the concentration loop was isolated and warmed to 80 °C. When the two gas chromatographs (GCs) reached their appropriate initial temperatures, the sample was injected into the helium carrier flow stream. The carrier stream was then split into two, with each sub-stream feeding a separate GC separation column. One 60 m x 0.25 mm I.D., 1.0 µm film thickness OV-1 column and one 30 m x 0.53 mm I.D., 10 µm film thickness Al_2O_3/Na_2SO_4 PLOT column were used for the trace gas separations. The effluent from the OV-1 column was split, with ~70% of the flow directed to an flame ionization detector (FID) for C_3-C_{10} NMHC measurements and ~30% to an electron capture detector (ECD) for C_1-C_2 halocarbon measurements. The PLOT column, which was housed in a separate GC, was connected to an FID for C_2-C_6 NMHC measurements. Further information regarding sample analysis and standard calibrations are described in *Sive*, [1998].

2.3 Spatial Analyses

The geographic locations of sample sites were logged with GeoExplorer 3 GPS devices. Positions constituting individual locations were downloaded into Trimble's® GPS Pathfinder Office software (Ver. 2.80) upon the completion of sample collection and were subjected to differential correction via post-processing utilizing base station data for the CORS site at Mammoth, WY (44 58 24.31849 N Lat.; 110 41 21.43409 W Long.)

that were downloaded through the internet. Horizontal accuracy levels for all sample points generally fell under 2 m, and did not exceed 2.3 m. To permit the mapping and spatial analysis of air samples, VOC data for each day's AM and PM sample period were merged with the post-processed and spatially merged GPS data in the GIS environment (i.e., ESRI's ArcView 3.2a). All data were projected in Universal Transverse Mercator units for integration with existing YNP spatial data. The resultant maps (Figures 3-18) portray the mixing ratios in parts per trillion by volume (pptv) of the selected VOCs. Owing to the coarse spatial resolution of the data, VOC concentrations are portrayed cartographically with scaled or graduated point symbols rather than a continuous interpolated surface.

3. Results and Discussion

Approximately 80 NMHCs and 15 halocarbons have been quantified from the 96 whole air samples collected in Yellowstone National Park. In this report, we present some preliminary results using a subset of trace gases measured from the whole air samples. The gases reported here include 14 C_2-C_8 NMHCs (including air toxics such as benzene, toluene and the xylenes) and tetrachloroethene (C_2Cl_4), a good marker for long range transport of urban air. C_2Cl_4 is used to illustrate that urban emissions did not affect the sampling region during the course of our sampling experiment.

3.1 Exhaust Samples

Exhaust samples were collected from a two-stroke and a four-stroke snowmobile in order to compare the relative emission ratios of the two different engine types. The two-stroke exhaust sample was collected from a *Polaris Trail Touring* snowmobile equipped with a 550 cc fan-cooled engine while the four-stroke exhaust sample was collected from a *Polaris Frontier 4 Stroke* snowmobile equipped with a 780 cc liquid-cooled engine. The exhaust samples were collected in 1-liter silica lined canisters (Entech Instruments, Simi Valley, CA) immediately after completing a 75 minute transit from Old Faithful to West Yellowstone. For both snowmobiles, the samples were collected at 5000 RPM, which corresponded to the average revolutions per minute for each engine during the transit. For sample collection, the brake was applied and the engine was held at 5000 RPM while the canister was placed directly into the exhaust stream exiting the tailpipe of each engine and filled to ambient pressure. A 0.5 cm^3 (STP) aliquot of each exhaust sample was analyzed by direct injection using the analytical system described previously. From the chromatographic data obtained for these samples, relative emission ratios for each engine type were determined. Results from the exhaust sample analyses indicate that the two snowmobiles sampled had very similar emission ratios for both ethene and ethane. For this comparison, we have normalized the emission ratios to ethene; however, the results do not differ if they are normalized to ethane. The emission ratios relative to ethene for the two-stroke and four-stroke snowmobile engines are illustrated in Figure 2.

Overall, the relative emission ratios for the two-stroke engine are significantly larger for all of the reported compounds (Figure 2). Toluene dominated the two-stroke engine emissions (approximately five times larger than the four-stroke engine), but relatively large amounts of n-butane, i-pentane and n-pentane were also present in the exhaust sample. For both engine types, only a small fraction of the exhaust consisted of ethane, propane, propene, and i-butane. With regard to air toxic emissions (i.e., benzene, toluene, ethylbenzene and xylenes), the two-stroke engine emitted significantly larger quantities of these gases.

3.2 Overview of Spatial Distributions

The spatial distributions of the 16 reported gases are shown in Figures 3 through 18. Each figure contains four maps corresponding to the morning and afternoon sampling periods during the low and high traffic days (Wednesday and Saturday, February 13 and 16,2002). Mixing ratios are in pptv and are designated by color-coding and symbol size. One feature worth noting before discussing the trace gas spatial distributions is that the road between Silver Gate and Mammoth Hot Springs is used primarily for automobile traffic, as opposed to the remainder of the park roads which are dominated by snowmobile traffic. Therefore, the samples collected in the northern region of the park were generally much cleaner, and the NMHC mixing ratios were only slightly enhanced above background northern hemispheric air.

In order to assist in ruling out the influence of urban emissions on the samples collected in the park, the spatial distribution of C_2Cl_4 was evaluated (Figure 3). For all AM, PM and diurnal samples, the mean C_2Cl_4 mixing ratio and 1σ standard deviation were 7.6 ± 1.1 pptv (the standard deviation at this mixing ratio level is dominated by the instrument's precision). This indicates that there was little or no influence on the air masses sampled in the park from urban areas directly upwind and that the NMHC enhancements observed were representative of local emissions.

The ethane and propane spatial distributions are shown in Figures 4 and 5. For both of these gases, high concentrations were observed at Silver Gate during the morning sampling periods. It is likely that these enhancements were a result of wood burning (used for home heating) and LPG leakage in this area. With the exception of the high values observed in the morning at Silver Gate, the ethane mixing ratios were essentially uniform indicating that the air masses sampled were well mixed throughout the park on both days. Similarly, little variability was observed in the propane mixing ratios during both sampling periods.

Ethene and propene are useful indicators of fresh emissions from combustion sources because of their short atmospheric lifetimes, which are on the order of ~1.5 days and ~0.5 days, respectively. Ethyne, also an indicator of combustion, has an atmospheric lifetime on the order of 2 weeks, resulting in its higher background concentrations. The spatial distributions of these three gases are shown in Figures 6 through 8. As with ethane and propane, the mixing ratios of these gases were also relatively large in the morning samples collected at Silver Gate during both sampling days. However, noticeable enhancements are observed throughout the southern two-thirds for ethene and ethyne during the PM sampling period on both days. Also, enhancements for all three

gases are observed during the PM sampling period at the West Yellowstone entrance. A key feature to note is that the mixing ratios for ethane and ethyne increased between the AM and PM samples. With regard to propene, there is essentially no enhancement throughout the park, especially on the high traffic day, which is consistent with the relatively small fraction of propene emitted from both two-stroke and 4 stroke snowmobiles.

The butanes (i-butane and n-butane) and pentanes (i-pentane and n-pentane) are indicators of fuel evaporation and are also emitted from combustion sources. The spatial distributions of these gases are shown in Figures 9 through 12. For i-butane, the overall difference between the morning and afternoon mixing ratios is small on both days. In contrast to i-butane, the n-butane, i-pentane and n-pentane show large enhancements between the AM and PM sampling periods on each day. The observed enhancements are likely a result of the increased snowmobile usage between the AM and PM sampling periods. However, because the road from Mammoth Hot Springs Silver Gate to is limited to automobiles, the mixing ratios of these gases remain essentially unchanged in this region for all sampling periods. Again, the large enhancements observed for n-butane, i-pentane and n-pentane are consistent with the two-stroke snowmobile exhaust sample.

Similarly, benzene, toluene, ethylbenzene and the xylenes (m-, p- and o-) exhibit spatial distributions comparable to n-butane and the pentanes, with toluene emissions showing the greatest increases between the AM and PM sampling periods (Figures 13 through 18). The potential health hazards associated with exposure to these compounds are the primary reasons for controlling their emissions, thus their classification as federal hazardous air pollutants. The largest mixing ratios (reported here in *parts per billion* by volume, ppbv) observed for each of these compounds were comparable to those found in a polluted urban environment [*Monod et al.*, 2001] illustrating the probable impact of the snowmobile emissions on the airshed. The ratios were as follows: benzene – 4.82 ppbv; toluene – 9.89 ppbv; ethylbenzene – 0.99 ppbv; m-xylene – 3.01 ppbv; p-xylene – 1.37 ppbv; o-xylene – 1.54 ppbv. To put these values into perspective, background mixing ratios for these compounds are expected to be on the order of the following: benzene ~ 100 pptv; toluene ~ 40 pptv; ethylbenzene and the xylenes ~ 5 pptv.

3.3 Comparison of Low and High Traffic Days

Table 3 lists the median and mean mixing ratios in pptv, and percent difference in median mixing ratios between each sampling period to assess the impact of increased snowmobile traffic in the Park.

The decrease in concentration of ethane and propane between the AM and PM sample collections occurs regularly and is associated with the daytime heating of the earth's surface resulting in an increase in the planetary boundary layer height. This indicates that dilution is taking place with clean free tropospheric air mixing into the boundary layer. Even though air mass dilution is occurring, large enhancements in other trace gas mixing ratios associated with local snowmobile emissions were observed. Evaluating the percent difference of the median values for the samples collected on each day, the impact of the increased number of snowmobiles on the Yellowstone airshed can be assessed (median values are used for comparison rather than mean values so that the results are not skewed by samples with very high concentrations of NMHCs). The compounds listed in Table 3 all show enhancements in the percent difference of the median values between the low-traffic day and high-traffic day except for ethane, propane and C_2Cl_4. From these results, trace gas emissions from the snowmobile activity can be estimated. Overall, increased snowmobile usage resulted in an increase in median values for the reported trace gases.

4. Conclusions

The findings suggest that, holding overall levels of snowmobile usage steady, a reduction in the amount of two-stroke snowmobile traffic will likely reduce NMHC emissions including the air toxics benzene and toluene. This scenario essentially represents the *Winter Use Plans Draft Supplemental Environmental Impact Statement*'s Alternative 2. Alternatives 1a, 1b, and 3 will lead to significant decreases NMHC and air toxic levels in the Park.

5. Appendices

5.1 Tables

Table 1. Sample Sites and Codes

Sample Site	Site Code
Mammoth Hot Springs	A1
5 km West of Tower Junction	A2
Mammoth-Cooke City Rd. - 1 km West of Soda Butte Cr./Lamar R. Confluence	A3
Silver Gate	A4
Mud Volcano	B1
Canyon	B2
Norris Geyser Basin	B3
Yellowstone Lake Overlook	C1
East Entrance	C2
Old Faithful Lodge Area	D1
Fountain Paint Pots	D2
Madison River Bridges	D3
1 km South of West Yellowstone in Gallatin National Forest	D4
Old Faithful-Grant Village Rd. - Continental Divide (Eastern-most)	E1
Grant Village	E2
Grant Village-South Entrance Rd. – Approx. 8 km South of Lewis Lake	E3
Lake Ranger Station	DIURNAL

Table 2. Yellowstone Lake, WY Weather Conditions

Date	Min. Temp. F (C)	Max. Temp. F (C)	Min. Pressure. In (mbs)	Max. Pressure In (mbs)	Predominant Winds 7 am	Predominant Winds 1pm
Wednesday February 13th	-15 (-26)	24 (-4.4)	29.9(1012)	30.35(1027)	Calm	Calm
Saturday February 16th	-18 (-28)	26 (-3.3)	30.08(1018)	30.35(1027)	Calm	Calm

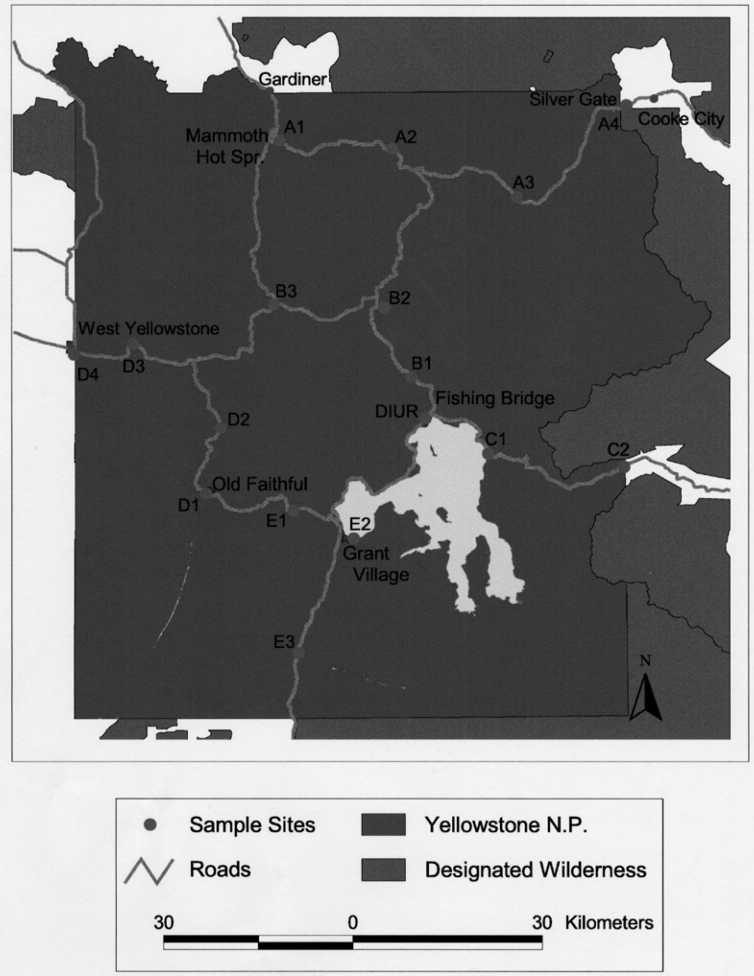
Table 3. Median and mean mixing ratios along with the percent difference in median values between morning and afternoon sampling times are reported for all samples collected throughout the park on the low traffic day (2/13/02) and high traffic day (2/16/02). All values were calculated using 14, 17, 16 and 17 samples for the 2/13/02 am, pm and 2/16/02 am, pm periods, respectively. On both days, morning samples were collected between 5 am and 7 am while afternoon samples were collected between 12 pm and 2 pm. All mixing ratios are reported in pptv.

Compound	Date	Sample Time	Median	Mean	% Difference
ethane	2/13/2002	am	1964.4	2147.3	
		pm	1829.5	1974.5	-7%
	2/16/2002	am	1796.9	1967.1	
		pm	1627.3	1732.2	-10%
ethene	2/13/2002	am	197.3	420.1	
		pm	159.6	825.6	-24%
	2/16/2002	am	104.1	835.6	
		pm	224.5	508.6	54%
ethyne	2/13/2002	am	432.0	553.7	
		pm	450.8	761.8	4%
	2/16/2002	am	358.2	669.3	
		pm	447.0	869.4	20%
propane	2/13/2002	am	672.5	1888.7	
		pm	662.5	894.8	-2%
	2/16/2002	am	586.4	2708.1	
		pm	470.0	585.3	-25%
propene	2/13/2002	am	49.5	164.6	
		pm	74.1	396.4	33%
	2/16/2002	am	38.5	336.9	
		pm	103.8	209.9	63%
i-butane	2/13/2002	am	128.6	179.0	
		pm	139.7	1206.8	8%
	2/16/2002	am	91.9	146.3	
		pm	145.6	260.7	37%
n-butane	2/13/2002	am	281.7	431.2	
		pm	352.5	2967.5	20%
	2/16/2002	am	213.8	365.3	
		pm	345.3	918.0	38%
i-pentane	2/13/2002	am	60.3	166.6	
		pm	121.9	1775.3	51%
	2/16/2002	am	46.6	181.1	
		pm	158.9	453.0	71%
n-pentane	2/13/2002	am	50.2	97.3	
		pm	68.5	1033.1	27%
	2/16/2002	am	35.2	114.5	
		pm	100.9	241.0	65%

Table 3 (continued). Median and mean mixing ratios for selected compounds along with the percent difference in median values between morning and afternoon sampling times.

Compound	Date	Sample Time	Median	Mean	% diff Med Values
benzene	2/13/2002	am	181.3	507.8	
		pm	156.1	420.4	-16%
	2/16/2002	am	147.6	241.0	
		pm	200.5	396.4	26%
toluene	2/13/2002	am	124	220	
		pm	149	1090	17%
	2/16/2002	am	98	277	
		pm	259	1205	62%
ethylbenzene	2/13/2002	am	10.5	25.7	
		pm	16.3	114.4	36%
	2/16/2002	am	9.7	28.7	
		pm	27.6	117.3	65%
m-xylene	2/13/2002	am	25.5	53.6	
		pm	21.3	302.3	-20%
	2/16/2002	am	28.5	65.9	
		pm	60.8	324.3	53%
p-xylene	2/13/2002	am	15.0	30.9	
		pm	30.9	171.4	51%
	2/16/2002	am	15.5	48.8	
		pm	44.2	107.9	65%
o-xylene	2/13/2002	am	18.4	34.5	
		pm	41.4	199.6	56%
	2/16/2002	am	18.4	40.5	
		pm	42.6	185.1	57%
C_2Cl_4	2/13/2002	am	8.1	8.4	
		pm	8.5	8.5	4%
	2/16/2002	am	7.4	7.2	
		pm	6.6	6.7	-12%

Sample Sites



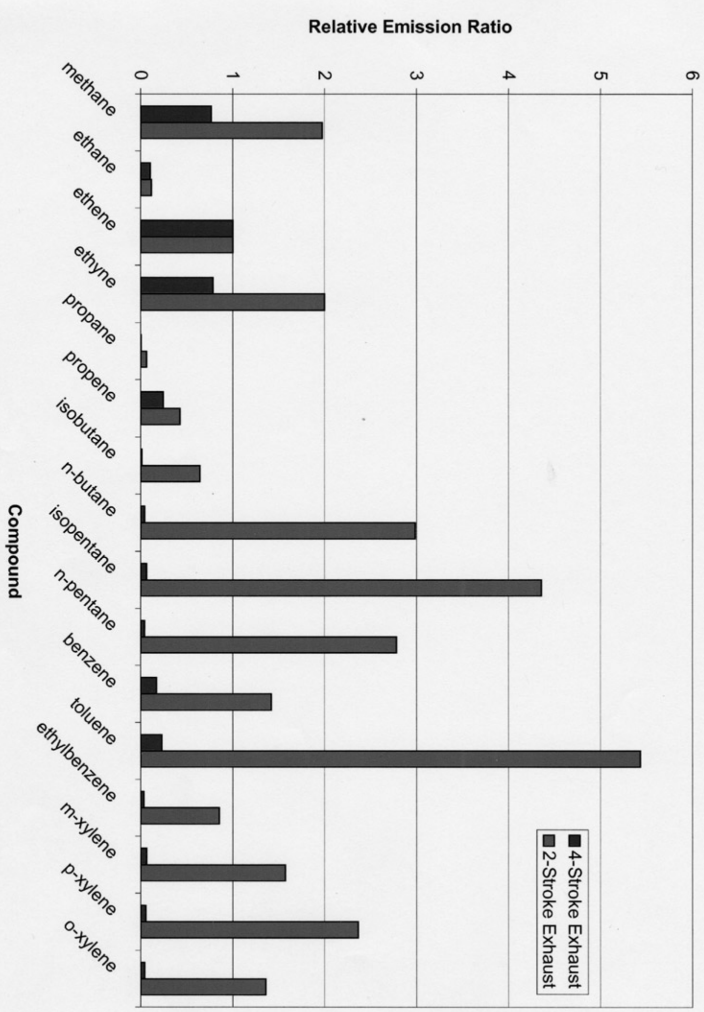
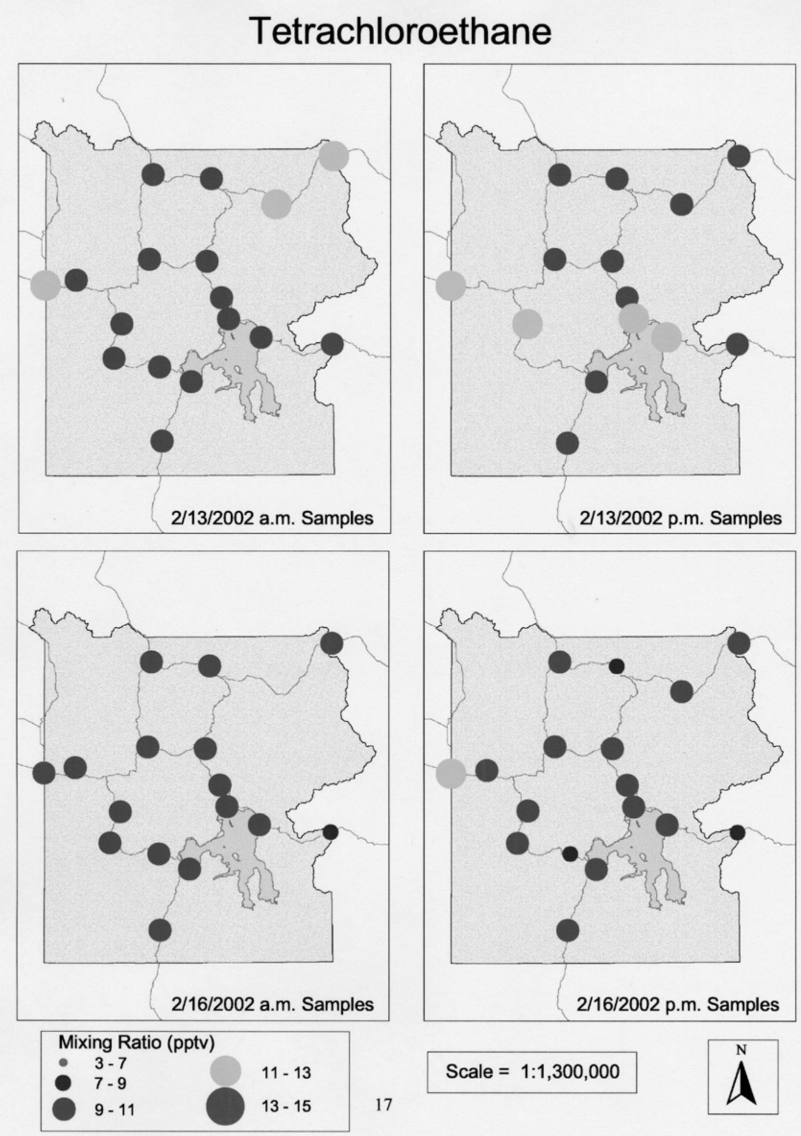
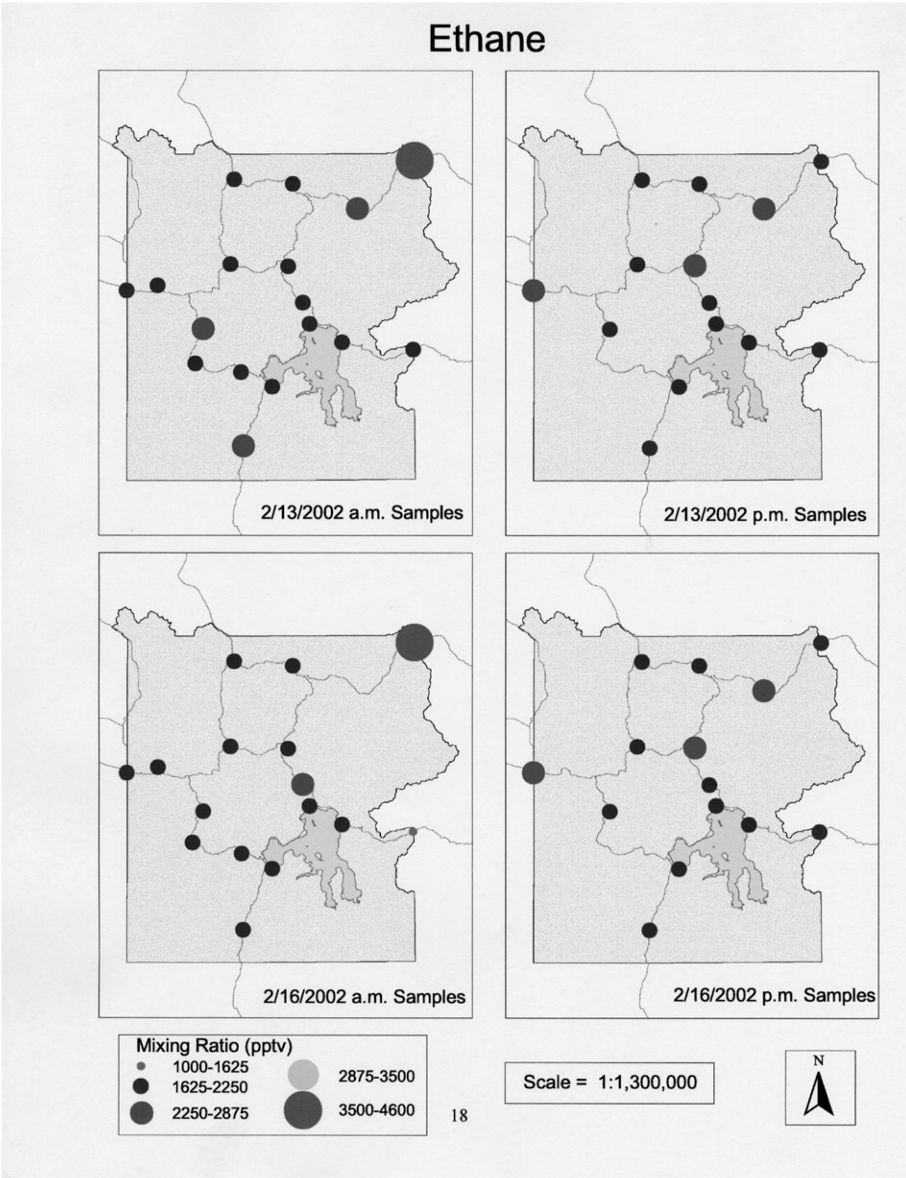


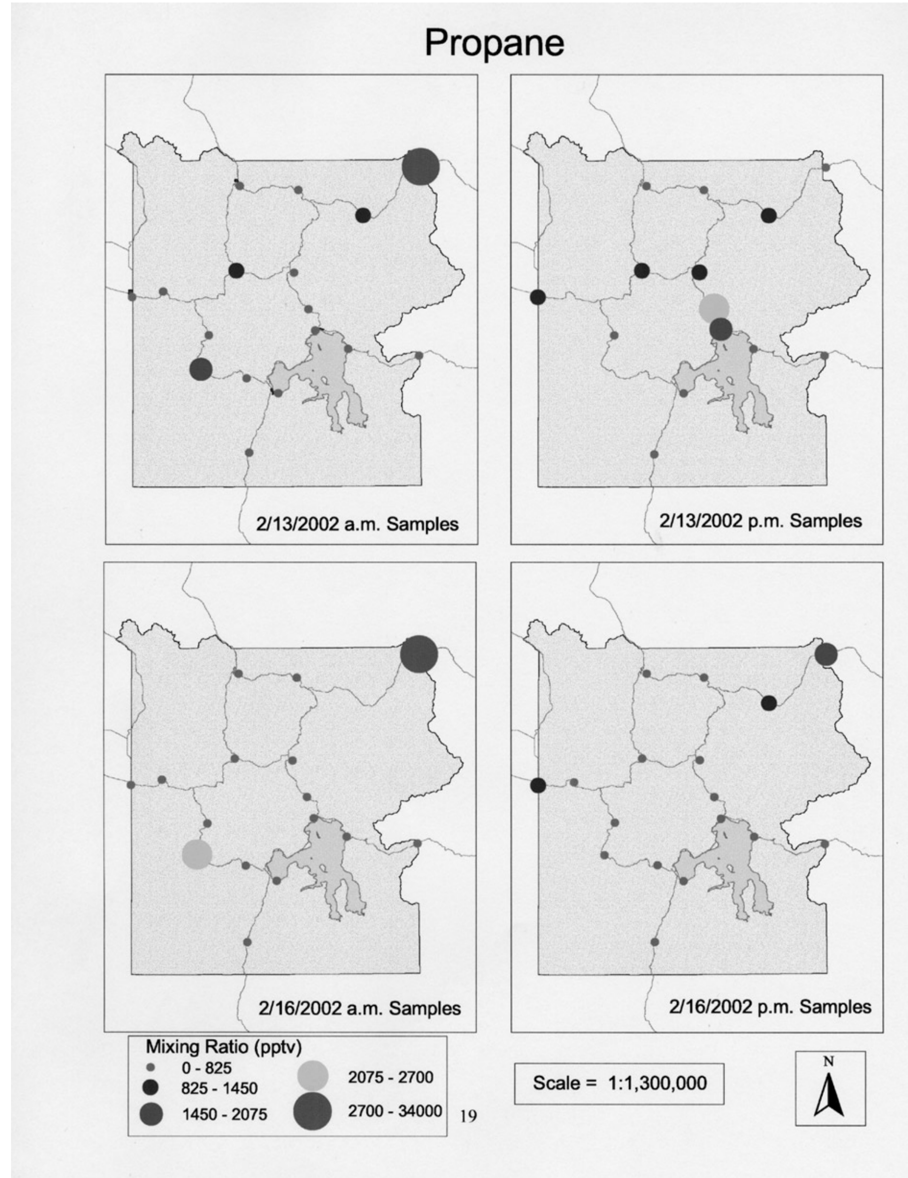
Figure 2. Relative Emission Ratios of Selected Compounds from 2-Stroke and 4-Stroke Snowmobile Exhaust Samples

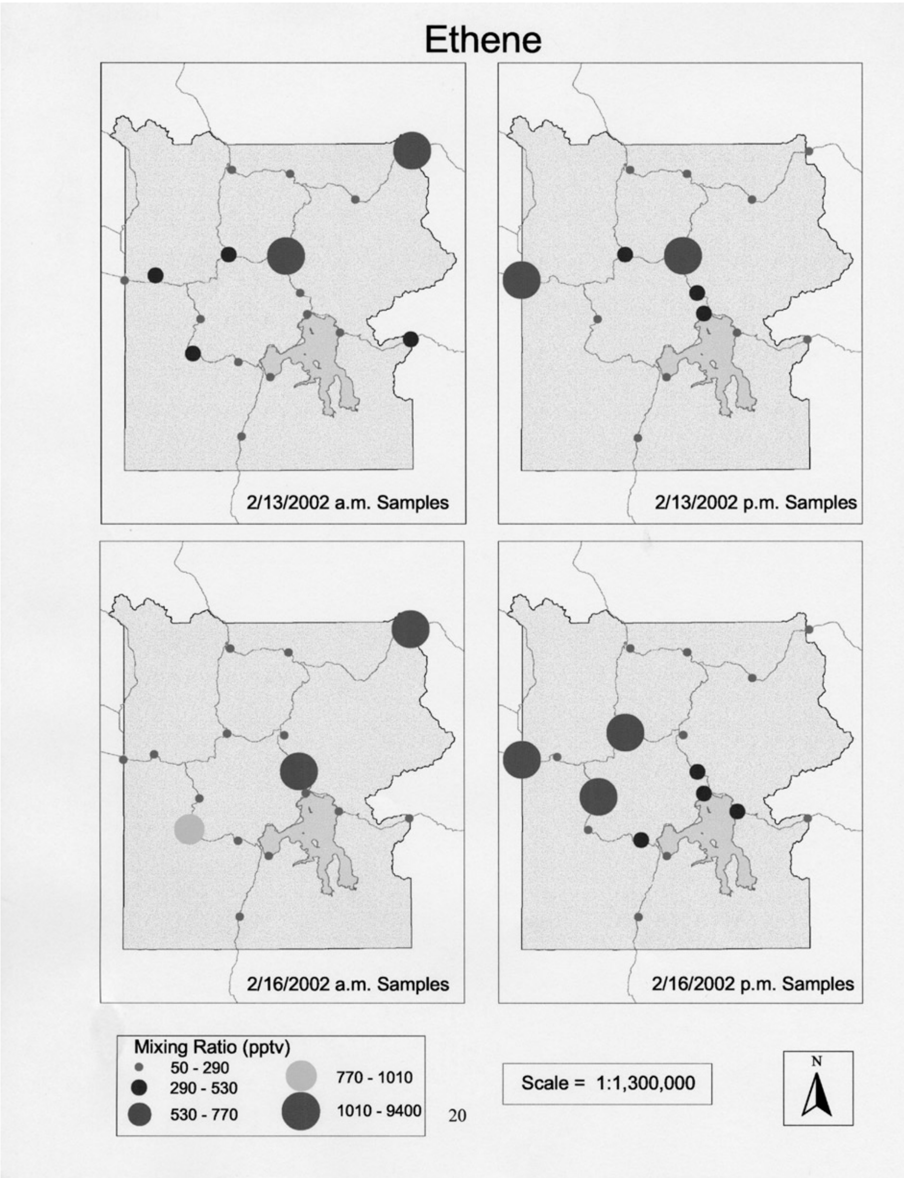
16

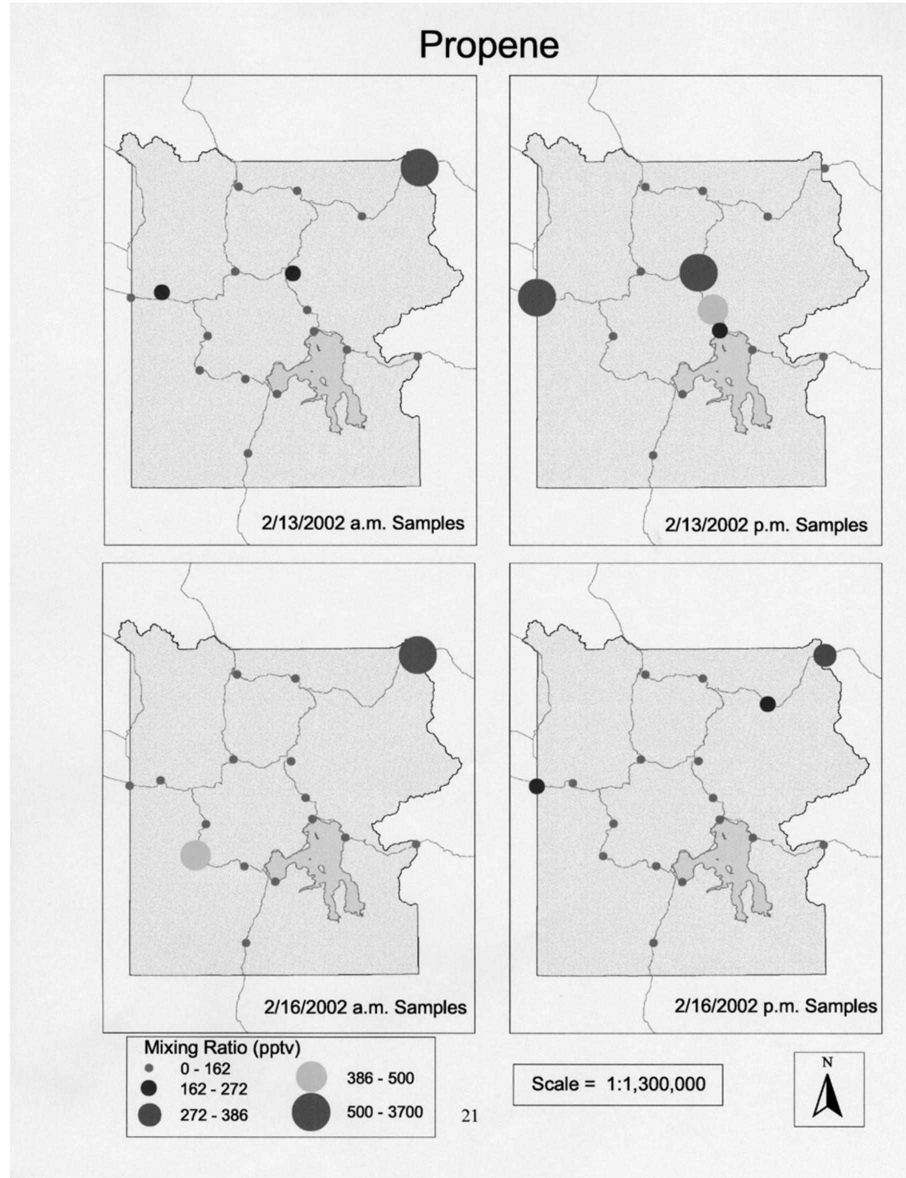


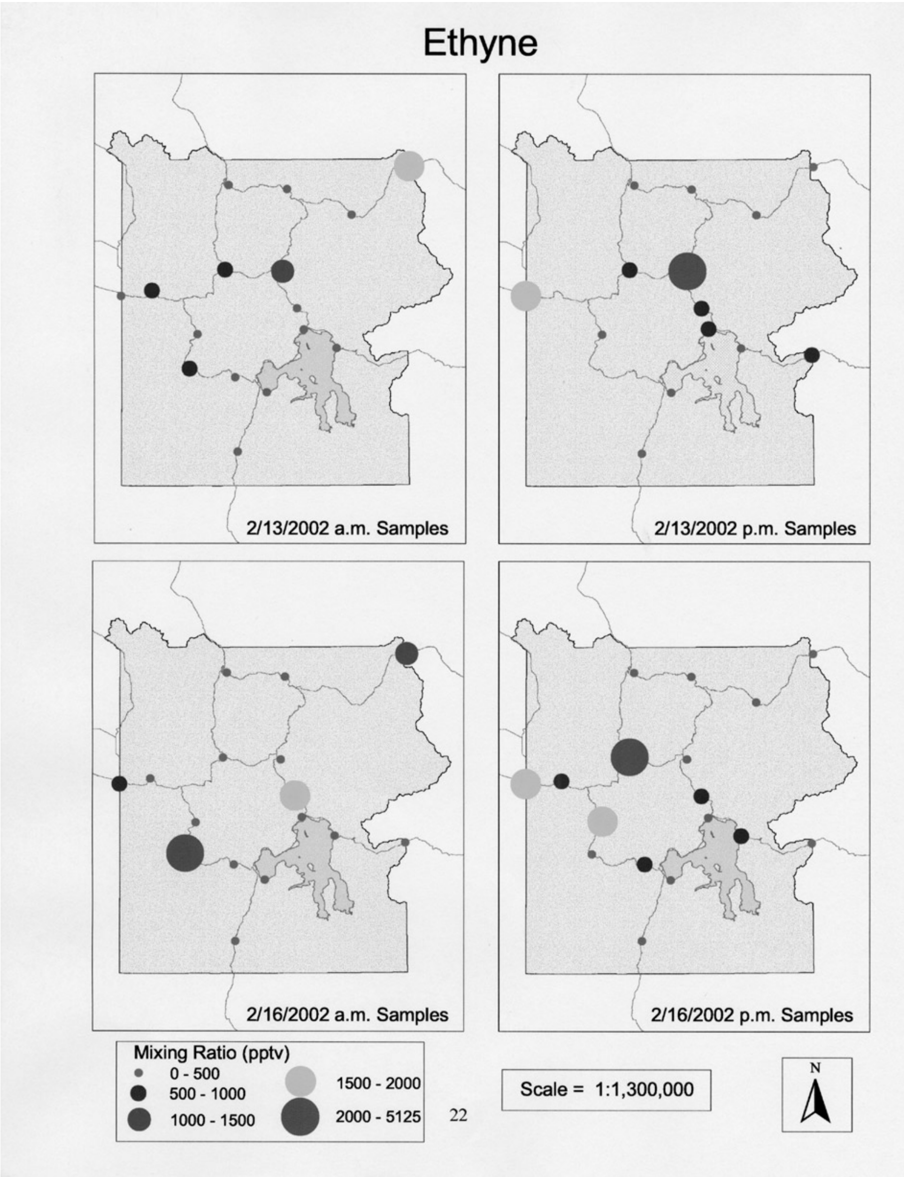
17

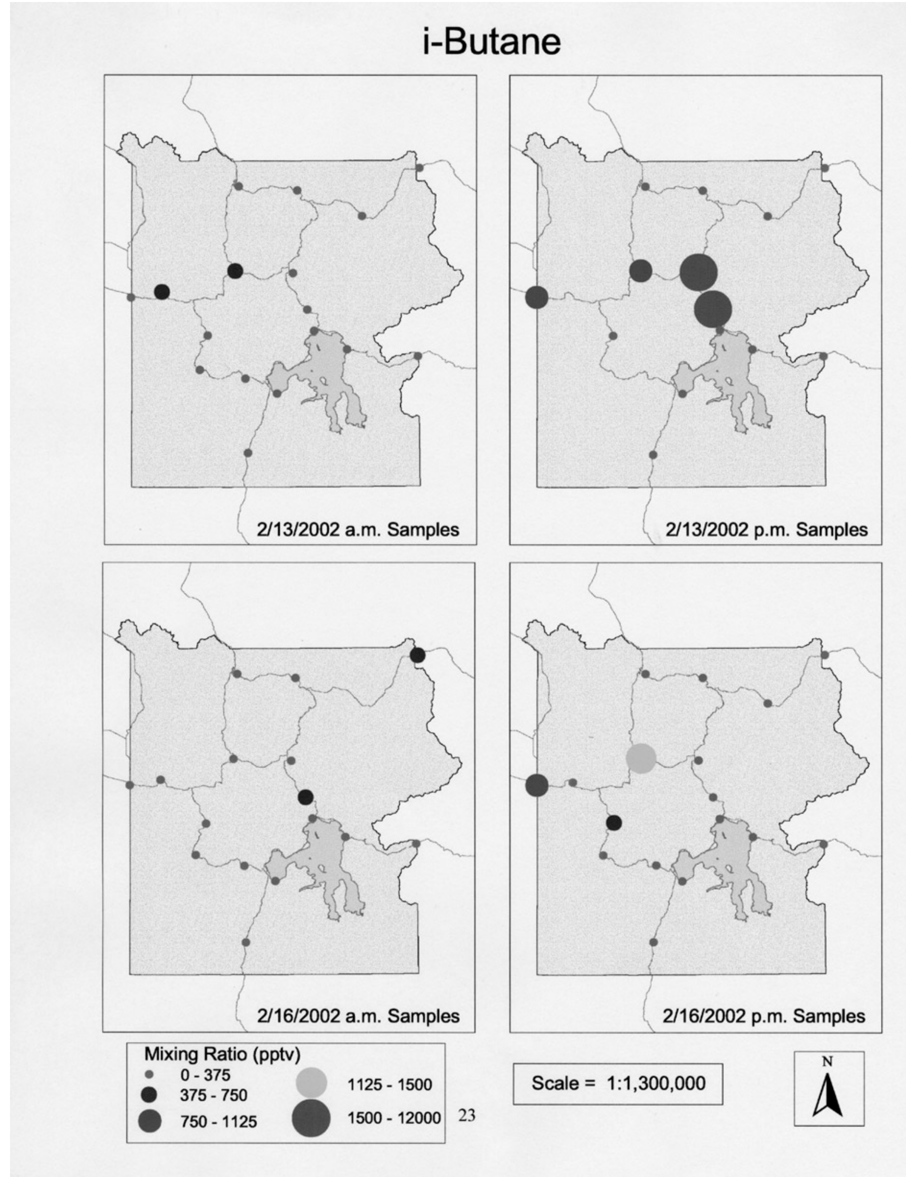

Ethane
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
1000-1625
1625-2250
2250-2875
2875-3500
3500-4600
Scale = 1:1,300,000
N
18

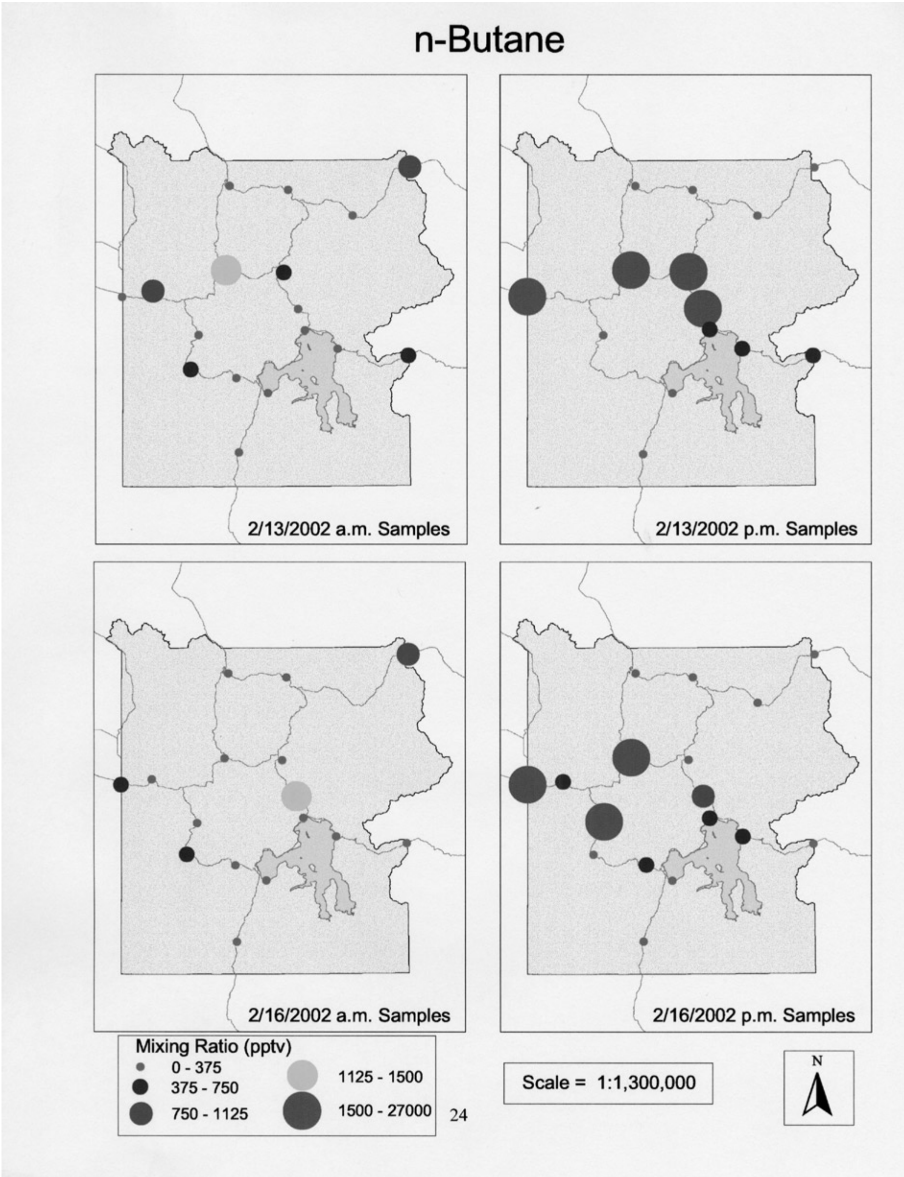

Propane
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 825
825 - 1450
1450 - 2075
2075 - 2700
2700 - 34000
Scale = 1:1,300,000
N
19

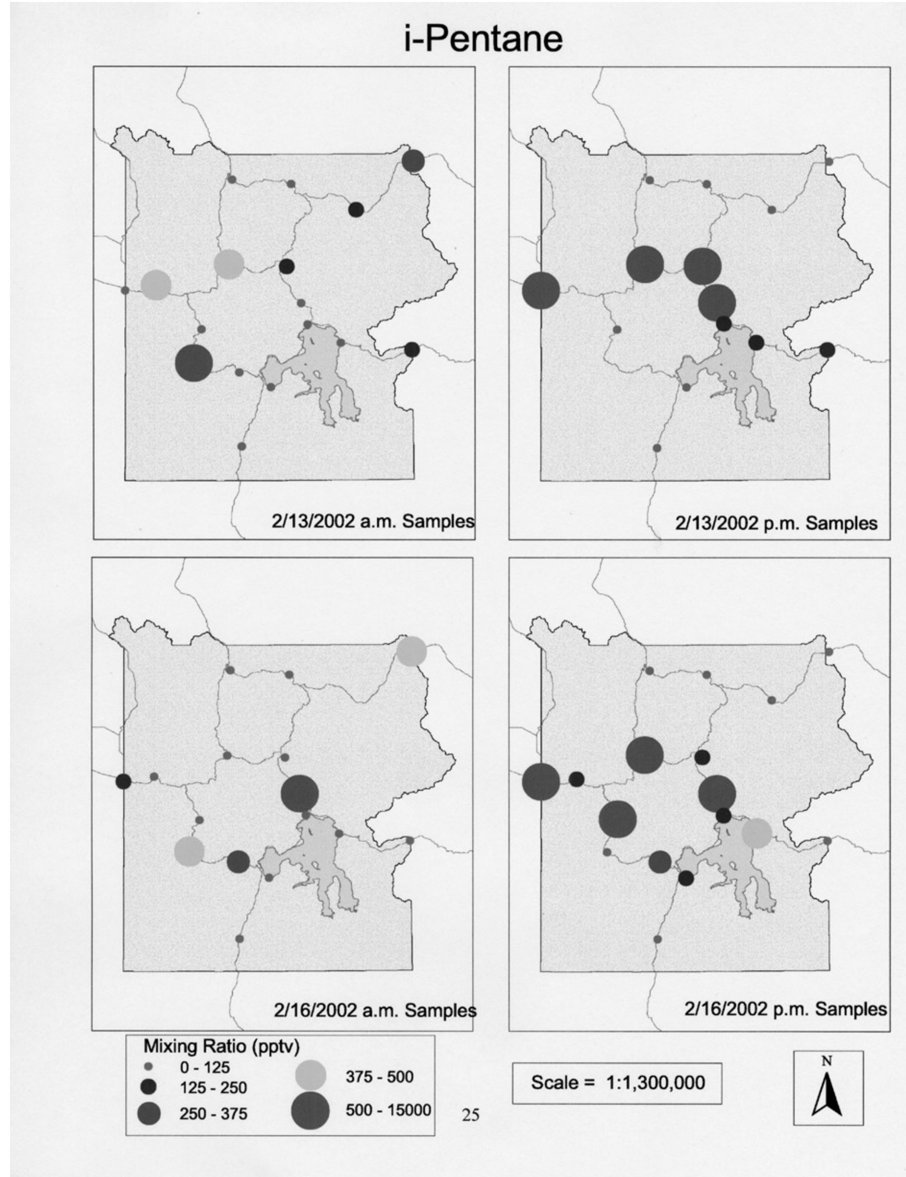

Ethene
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
50 - 290
290 - 530
530 - 770
770 - 1010
1010 - 9400
Scale = 1:1,300,000
N
20

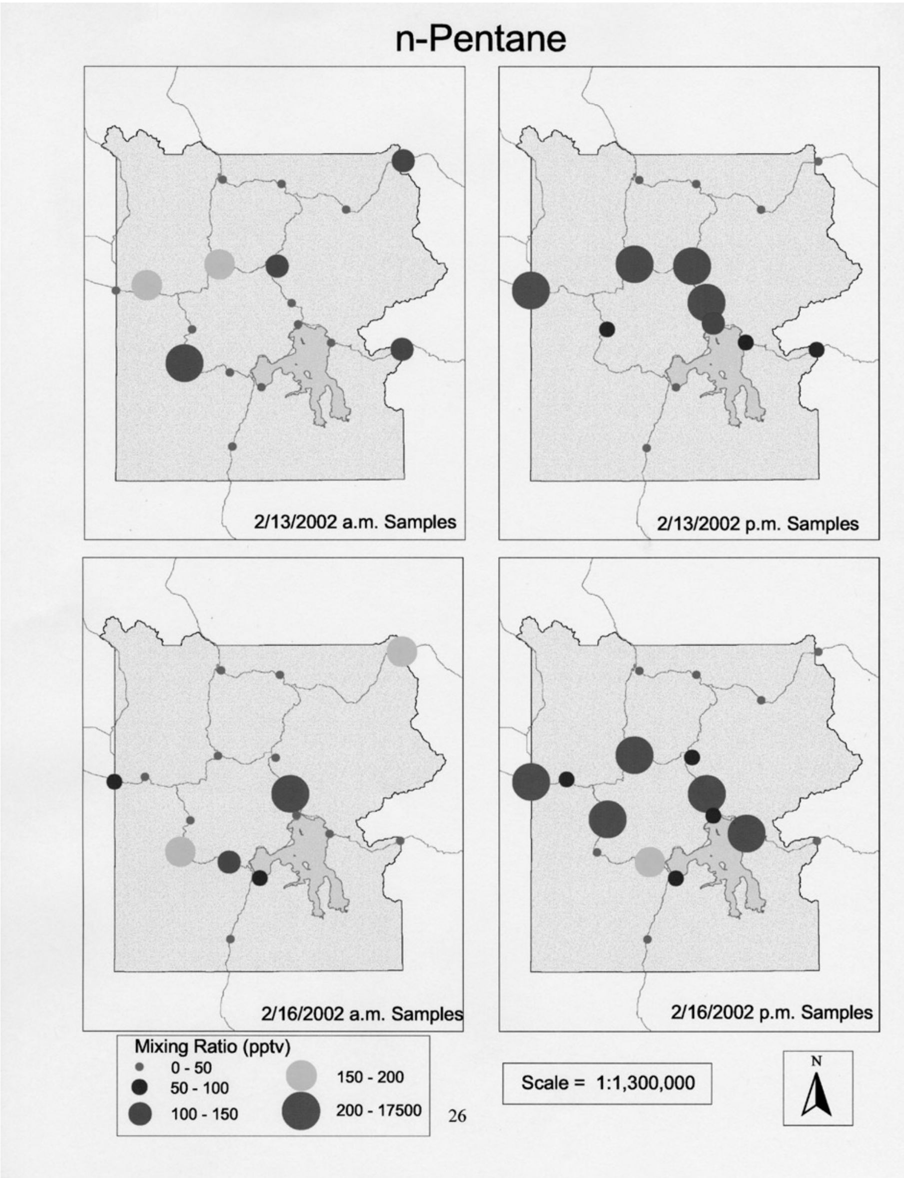

Propene
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 162
162 - 272
272 - 386
386 - 500
500 - 3700
Scale = 1:1,300,000
N
21

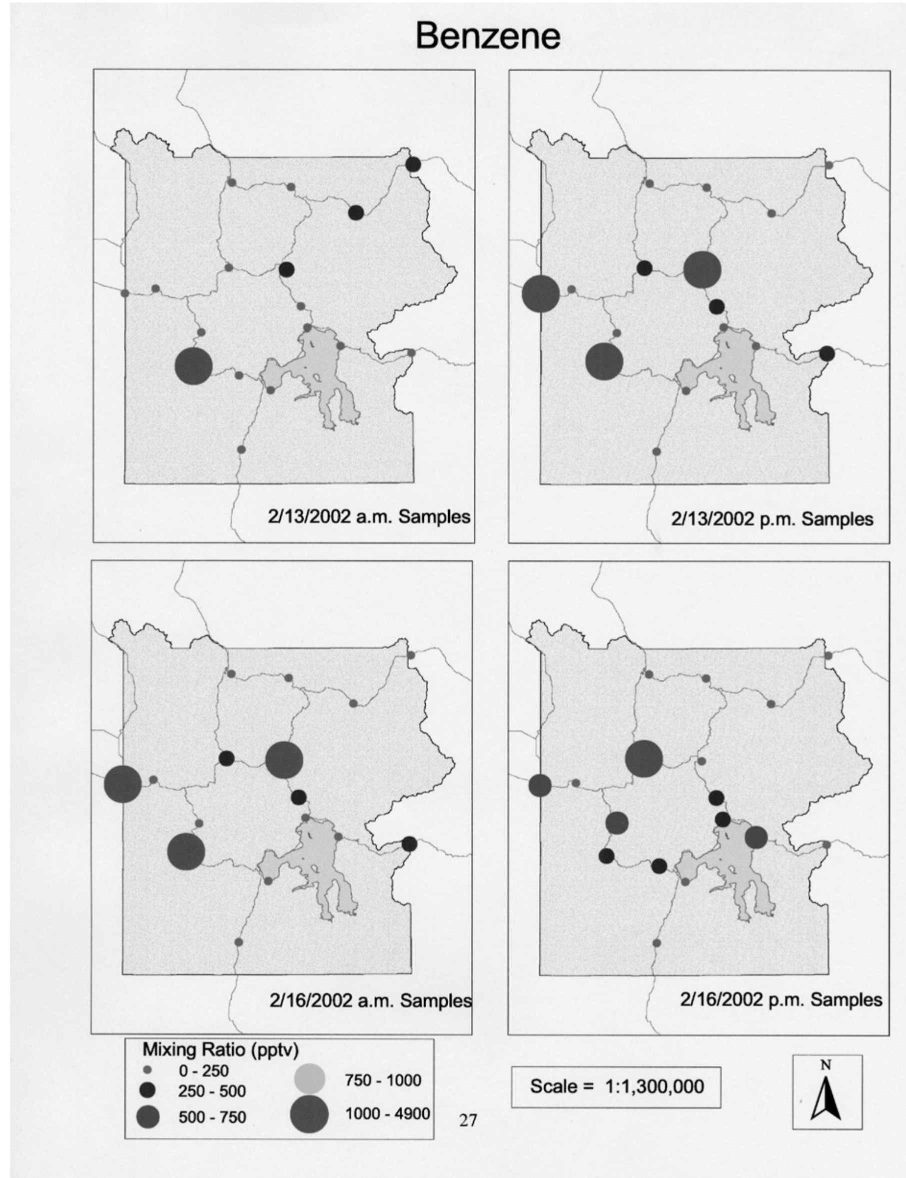

Ethyne
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 500
500 - 1000
1000 - 1500
1500 - 2000
2000 - 5125
Scale = 1:1,300,000
N
22

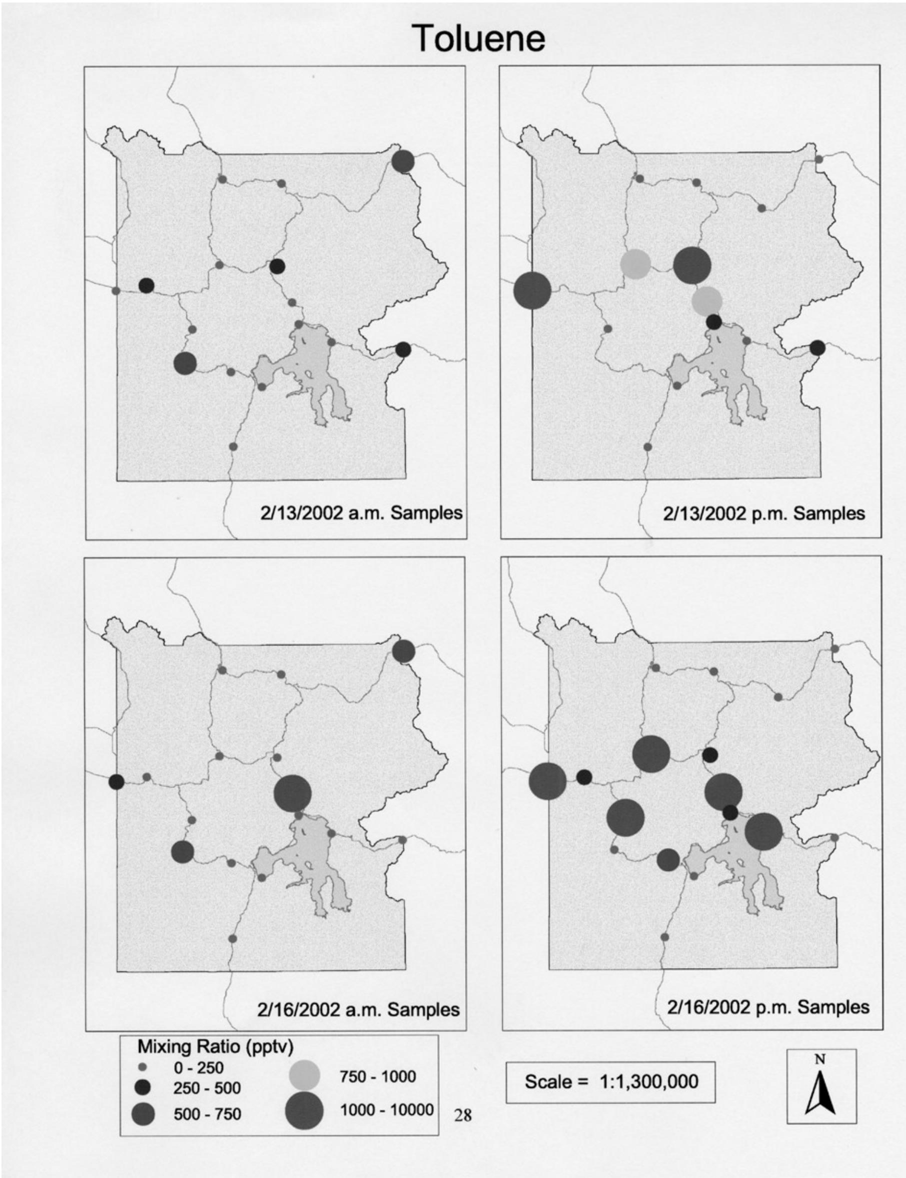

i-Butane
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 375
375 - 750
750 - 1125
1125 - 1500
1500 - 12000
Scale = 1:1,300,000
N
23

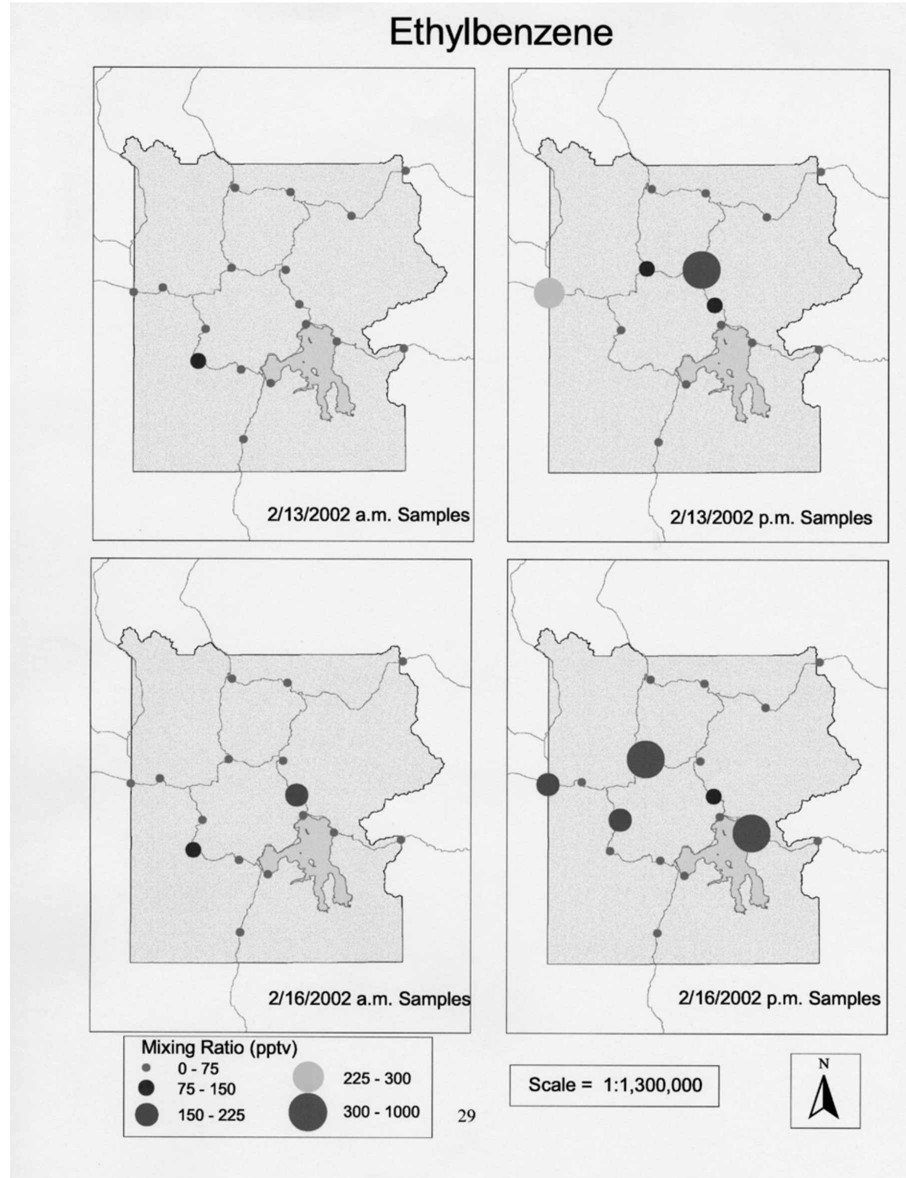

n-Butane
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 375
375 - 750
750 - 1125
1125 - 1500
1500 - 27000
Scale = 1:1,300,000
N
24

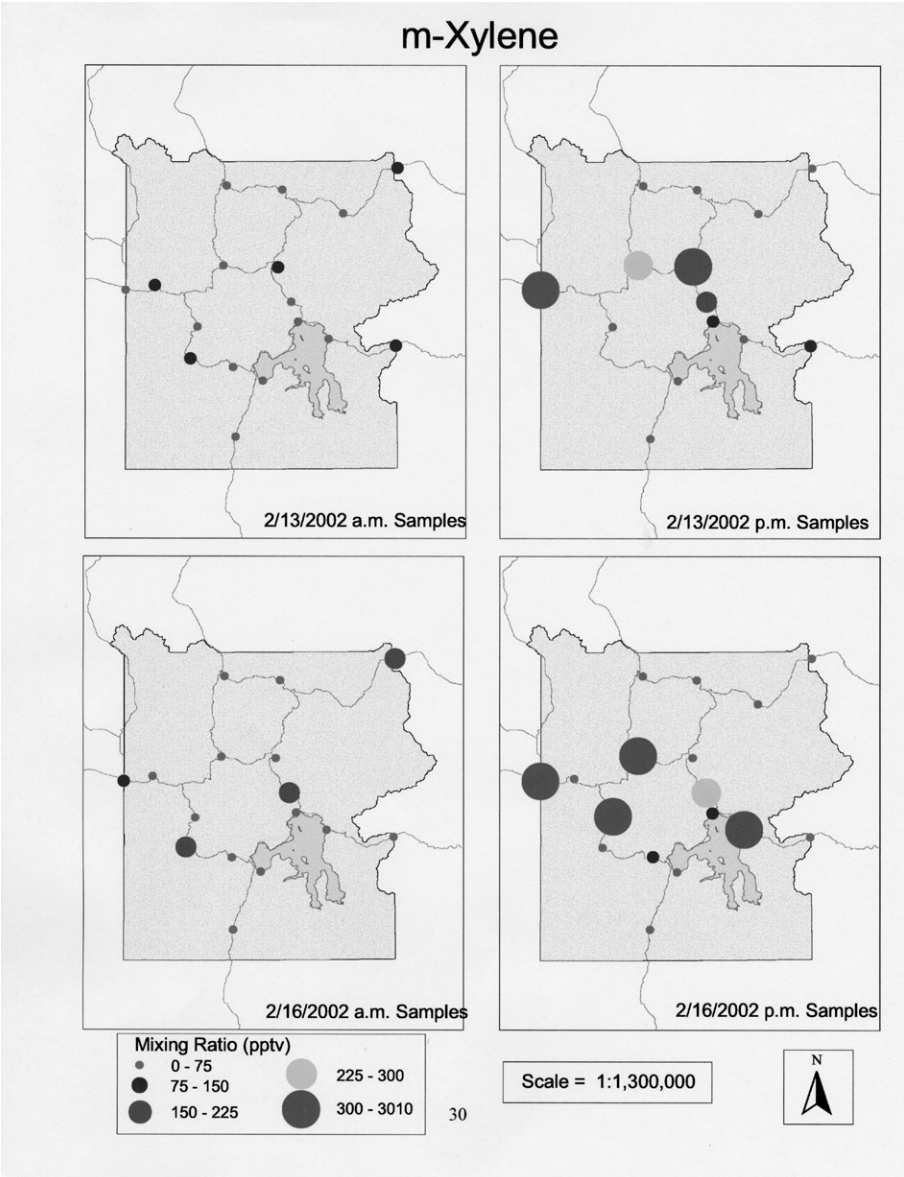

i-Pentane
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 125
125 - 250
250 - 375
375 - 500
500 - 15000
Scale = 1:1,300,000
N
25

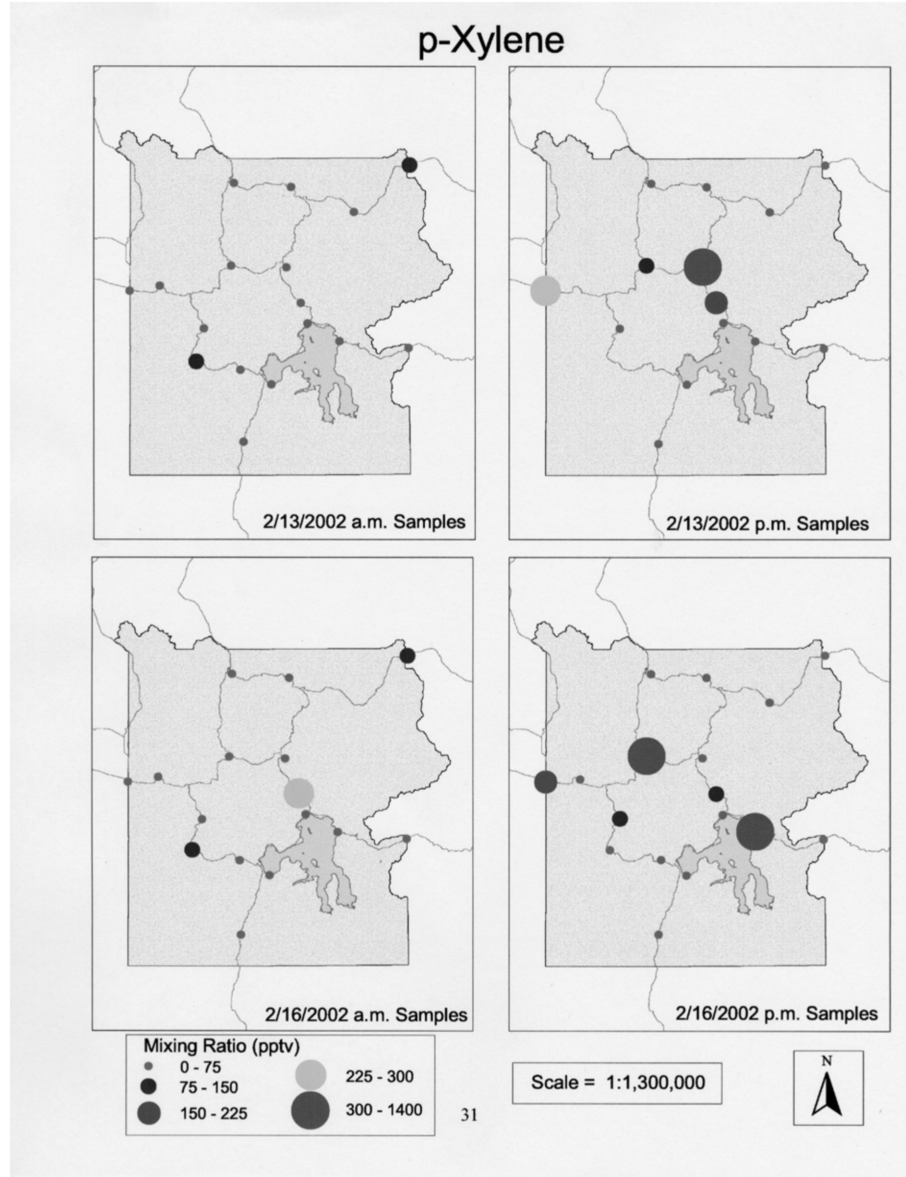

n-Pentane
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 50
50 - 100
100 - 150
150 - 200
200 - 17500
Scale = 1:1,300,000
N
26

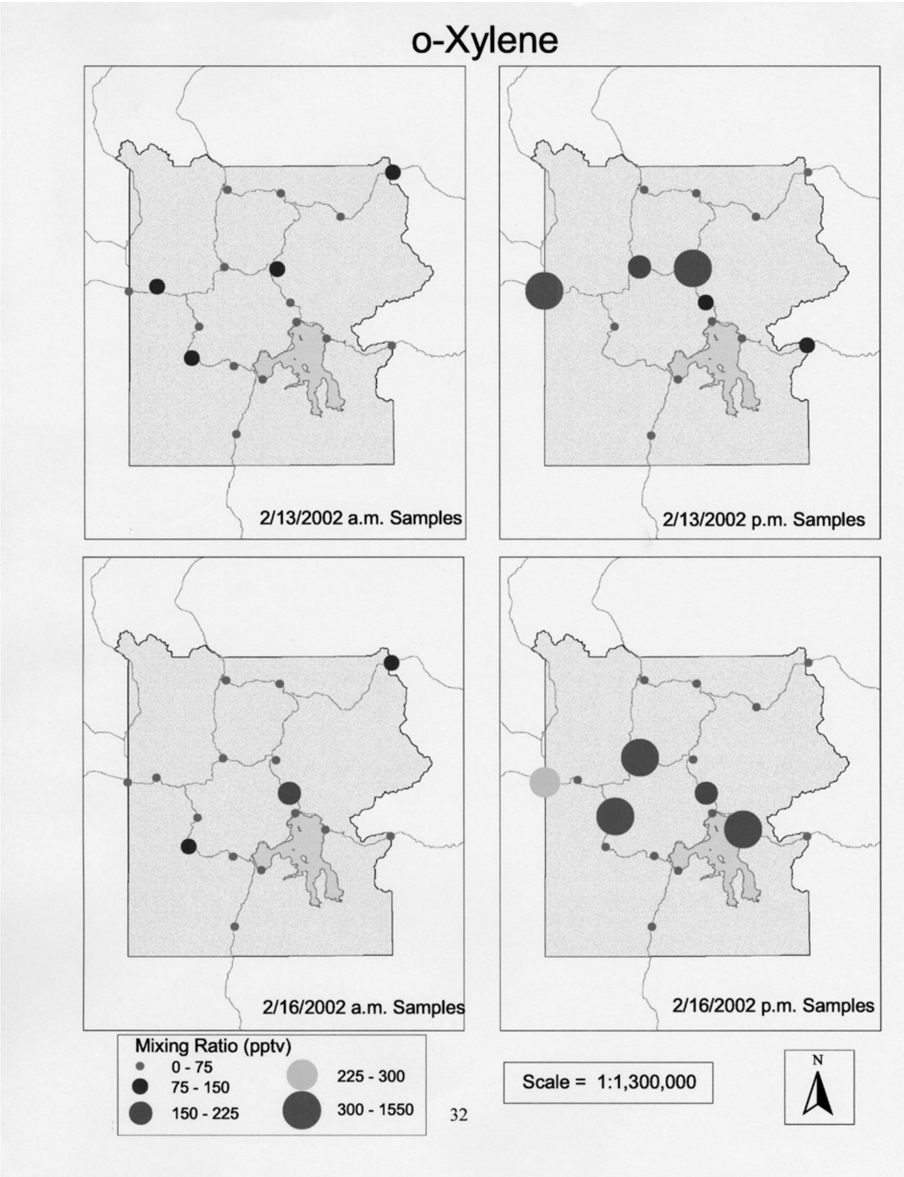

Benzene
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 250
250 - 500
500 - 750
750 - 1000
1000 - 4900
Scale = 1:1,300,000
N
27


Toluene
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 250
250 - 500
500 - 750
750 - 1000
1000 - 10000
28
Scale = 1:1,300,000
N


Ethylbenzene
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 75
75 - 150
150 - 225
225 - 300
300 - 1000
29
Scale = 1:1,300,000
N


m-Xylene
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 75
75 - 150
150 - 225
225 - 300
300 - 3010
Scale = 1:1,300,000
N
30


p-Xylene
2/13/2002 a.m. Samples
2/13/2002 p.m. Samples
2/16/2002 a.m. Samples
2/16/2002 p.m. Samples
Mixing Ratio (pptv)
0 - 75
75 - 150
150 - 225
225 - 300
300 - 1400
Scale = 1:1,300,000
N
31



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May 7, 2002

Winter Use Draft SEIS Comments
Grand Teton and Yellowstone National Parks
PO Box 352
Moose, WY 83012

To the National Park Service:

Whether one allows or bans snowmobiles from Grand Teton and Yellowstone National Parks is an issue which will never be answered to everyone's satisfaction because of its polarizing nature. People either love these machines or hate them with no middle ground. With that in mind any documents produced by the National Park Service, which argues for one side or the other, should have results which lack obvious errors, are consistent with the best available data and openly include all of the relevant data and modeling inputs. Then and only then will the recommendations be able to withstand the criticisms to surely follow.

The emissions modeling results provided in *Chapter IV: Environmental Consequences* of the Draft Supplemental Environmental Impact Statement (SEIS) fail all of these criteria and should be amended. A general sloppiness is found throughout the chapter and will leave a knowledgeable reader with the feeling that it was better to do the job fast than do it correctly. It is my opinion that this document, if used in its current form, will most likely find itself successfully challenged in court. The following pages contain my comments that I would like to have included in the administrative record.

Sincerely,

Gary A. Bishop

Dr. Gary A. Bishop
Department of Chemistry and Biochemistry
University of Denver

Cc: Sean Smith, Bluewater Network
Dr. John Ray, National Park Service
Howard Haines, Montana DEQ

1

Comments by Gary A. Bishop, University of Denver on "Winter Use Plans Supplemental Draft Environmental Impact Statement for the Yellowstone and Grand Teton National Parks and John D. Rockefeller, Jr. Memorial Parkway", May 7, 2002.

My first concern involves numerous crucial references made to a document not included in any of the SEIS materials nor referenced. Throughout the SEIS references are made to appendices which are part of a document referenced as (EA, 2001). In the SEIS' bibliography only a reference is given for a 2000 version of a presumably similar document used in preparing the FEIS. Most of the modeling input data (without which its impossible to completely evaluate the modeling) is contained in this missing document. It is imperative that it be release and available to the public along with the SEIS before final comments are accepted.

My second concern is that the emission factors used for the modeling in several instances do not take into account the best available data or are out of date and therefore have introduced large errors into the modeling results. The first error is found in table 40 on page 176. The CO emission factors given for 2000 model year light-duty gasoline trucks are just flat out wrong by at least an order of magnitude too high. On-road emissions of 2000 model year vehicles will meet or exceed the federal emissions certification standards independent of speed. I hope this is just a typo, but this error is also included in table 43 for the traveling emissions of the shuttle van. If this is the real input used for these vehicles then their emissions have been grossly over estimated.

The emission factors listed in Table 41 for the general public 2-stroke snowmobiles do not take into account the best available data. The EPA NONROAD model which these numbers were reported to be taken from contains very few if any actual snowmobile emission measurements. The NONROAD emissions database is so lacking in data that California has not even released their NONROAD model for that very reason. Any emission factors taken from this source should not be considered representative of fleet wide emissions. A better source for these emission factors would have been from actual measurements of thousands of snowmobiles collected at the West Entrance to Yellowstone National Park (Bishop et. al, "Snowmobile Contributions to Mobile Source Emissions in Yellowstone National Park", Environ. Sci. Technol. 2001, 35, 2874-2881). These data show that traveling CO emission factors for all of the snowmobiles listed in Table 41 are high by about a factor of 3.

The CO, HC and NO_x traveling emission factors listed in Table 43 for wheeled vehicle's are out of date and excessive. As previously mentioned, the value for the Shuttle Van is completely ridiculous. Fleet average on-road emissions having been annually decreasing by about 10%. Since these are referenced to an EPA AP-42 publication this would mean that these values probably originated from data collected before 1990. The CO and NO_x factors are high by about a factor of 2. The HC factors are high by a factor of 3 to 5. If you are going to model emission in 2003 and later you should take the time to include emission factors which are representative of that time period. These are easily estimated from EPA's annual report of emission trends in the US.

2

The use of a dispersion model for predicting ambient carbon monoxide (CO) levels is generally very problematic and should be avoided. This is because high outdoor levels of CO coincide with very low dispersion rates (read very little wind). The current dispersion models start to incorrectly predict ever increasing levels of CO as wind speeds plunge in much the same way that g/mile emissions go to infinity at zero speed. The low wind speeds used in the SEIS (1 meter/second) immediately raises a red flag that these results and the comparisons made using them may not be accurate. In addition all of the results in tables 44 and 45 (page 181) are given to 4 significant figures with no error estimates. This to me shows a lack of understanding in the significance, or lack thereof, of the outputs. The lack of any published error estimates is typical for EPA type computer models, however, that is no excuse for not including any sensitivity testing. Under these wind conditions I doubt that even the second significant figure has any statistical significance. The lack of any sensitivity testing (where wind speeds, mixing heights and emission factor inputs are changed and new results are calculated and compared) suggests that there are no statistically significant differences between the 4 modeled alternatives.

An alternative to sensitivity testing of the model is to compare the modeled outputs to hourly averaged CO or PM_{10} data for one of the sites. In this way we can also get an idea as to how meaningful the predictions are not only at that site but at all of the sites modeled. The state of Montana has been collecting hourly average CO emissions at the West Entrance to Yellowstone National Park since Oct of 1998. Currently data are available through December of 2001. This data record should be referenced and included in the final document.

The baseline case (Alternative 1b year 1) is identical to the situation at the west entrance for the winters of 98-99, 99-2000 and 2000-2001 and can be compared to the ambient data. One of the first things you notice when you look at the ambient data is that the mornings, which were modeled exclusively, are not the periods with the highest observed hourly average CO concentrations. These occurred between 16:00 and 18:00 hours most likely because the inversion layer is lower and more stable in the afternoon than in the morning. The ambient data record also shows that the selection of hourly and 8 hour average background CO concentrations are again biased high (most likely because the data used is not really a background sample for the park entrance). The west entrance data shows that the background CO concentration are all less than 0.5 ppm not the 3.0 ppm used for the hourly average and 2.1 ppm used for the eight hour average. These should be corrected in the final document.

For the mornings at the west entrance during the 3 winter seasons of data the highest observed hourly CO average was 13.1 ppm with an additional 5 hours with readings greater than 10 ppm. The eight hour averages are much lower with the highest values in the 4 to 6 ppm range. These data show that the dispersion model is over predicting measured CO concentrations by factors of 2 to 4 for the baseline case. This also means that all of the tons per year that are presented are over predicted by the same factors as well. Most likely if the correct emission factors for 2-stroke snowmobiles had been used, credibility would be improved because the baseline case would be in much better

agreement with the data at the west entrance. There is no reason to believe that the PM_{10} predictions are not equally incorrect.

Finally the description of the total mobile emissions starting on page 202 and listed in Table 73 should define which tons are being calculated. Short tons (2000 pounds) or metric tonne, which are the preferred international unit.

Gary Bishop
<gbishop@du.edu>
05/06/2002 01:55 PM
CST

To: grte_winter_use_seis@nps.gov
cc:
Subject: Draft air quality analysis report

To whom it may concern:

Your SEIS air quality analysis section is peppered with Appendix references to a Draft Air Quality Analysis Report (EA 2001). In the bibliography there is no reference for a 2001 report only a reference to what appears to be a similar document published in 2000 with the FEIS. It is next to impossible to fully evaluate the Air Quality modeling without this document. Could you please send it to me or tell me where I can download it.

Thanks,

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Robert Keiter
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>
05/29/2002 05:46 PM
CST

To: "grte winter use seis@nps.gov" <grte_winter_use_seis@nps.gov>
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Dear Sir or Madam:

I am writing to comment on the Draft SEIS on winter use planning in Yellowstone and Grand Teton national parks, and to express my support for the original snowmobile phase-out decision as reflected in Alternative 1a. The following comments reflect my more than 15 years professional experience as a legal scholar examining national park law and policy. My relevant publications include: The Greater Yellowstone Ecosystem: Redefining America's Wilderness Heritage (Yale Univ. Press 1991); Preserving Nature in the National Parks: Law, Policy, and Science in a Dynamic Environment, 74 Denver U. L. Rev. 649 (1997); Bison, Brucellosis and Law in the Greater Yellowstone Ecosystem, 28 Land & Water L. Rev. 1 (1993); Taking Account of the Ecosystem on the Public Domain: Law and Ecology in the Greater Yellowstone Region, 60 U. Colo. L. Rev. 923 (1989). In addition, I currently serve as a trustee for the National Parks Conservation Association. The comments that follow reflect my professional and personal views; they do not reflect the views of the University of Utah College of Law or any other organization.

The original Winter Use FEIS snowmobile phase-out decision is fully consistent with the 1916 National Parks Organic Act that vests the Park Service with an unambiguous legal obligation to protect park resources in an "unimpaired [condition] for the enjoyment of future generations." 16 U.S.C. § 1 (2001). Congress reaffirmed this legal obligation in the 1978 so-called Redwood Amendment, which provides that "... the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park system and shall not be exercised in derogation of the values and purposes for which these areas have been established..." 16 U.S.C. § 1a-1 (2001). The courts have consistently read these statutory provisions as obligating the Park Service to give resource protection priority over visitor or recreational activities that could threaten park resources. In Bicycle Trails Counsel v. Babbitt, 82 F.3d 1445 (9th Cir. 1996), while acknowledging that the Golden Gate National Recreation Area enabling legislation specifically allowed recreational uses, the Ninth Circuit Court of Appeals ruled that the Park Service properly gave resource protection priority over recreation when it stringently regulated mountain bike use in the park. See also Michigan United Conservation Clubs v. Lujan, 949 F.2d 202 (6th Cir. 1991) (holding that under the Organic Act wildlife preservation takes precedence over user enjoyment). The Eighth Circuit, in Mausolf v. Babbitt, 125 F.3d 661 (8th Cir. 1997), also relied upon the Organic Act and the Park Service's snowmobile regulations to sustain a Voyageurs National Park snowmobile closure order based upon evidence of wildlife harassment. The cases collectively stand for the principle that the Park Service is obliged to prohibit intensive recreational activities that are found to damage or impair park resources.

Moreover, the 2001 Management Policies document further refines these protective obligations, providing that "the Park Service must leave park resources and values unimpaired unless a particular law directly and specifically provides otherwise." NPS Management Policies 1.4.4 (2001). There is no such law regarding snowmobiles in the Yellowstone region parks. In sum, the Organic Act and other laws governing the national parks provide firm legal support for the original phase-out decision, and there is no legal basis for reversing this decision.

In the case of recreational snowmobiling in the Yellowstone region national parks, the Park Service has already made unambiguous resource damage findings that include harm to park "wildlife, air quality, and natural soundscapes and natural odors." NPS, Record of Decision (Nov. 2000). Subsequent information gathered during this supplemental EIS process has not altered these basic impairment findings. According to the Draft SEIS, if snowmobile use is allowed to continue, air quality will not be improved significantly (DSEIS, at 204-05), wildlife impacts will not be reduced (id. at 215-19), and the natural soundscape will not be restored (id. at 248-50). In fact, after reviewing the new DSEIS information, the Environmental Protection Agency has reaffirmed its view that the "FEIS Alternative G remains the environmentally preferred alternative," noting that it "provide[s] the best available protection to human health, wildlife, air quality, water quality, soundscapes, visitor experiences, and visibility" and that "Alternatives 2 and 3 both have elements that result in significant uncertainty in understanding their effects on future air quality, potentially extending the threat to air quality standards beyond that disclosed in the DSEIS." See EPA DSEIS Comments; EPA Cover Letter 4/23/02. Thus, whether measured in terms of resource impairment or visitor experience, the available data still clearly indicate that continued snowmobile use will impair the parks. There is, in short, no factual basis for reversing the original impairment conclusion and phase-out decision.

As a matter of national park policy, the Park Service correctly concluded in the 2000 Winter Use FEIS to eliminate recreational snowmobile use in the Yellowstone region national parks-a decision that established an important precedent regarding motorized recreation in America's national parks. Even a cursory examination of the growing increase in snowmobile visitors to Yellowstone region parks (not to mention the unrelenting pressure to expand motorized recreation activities in national parks and elsewhere on the public lands) highlights the real importance of this issue. In little more than 40 years, Yellowstone's snowmobile visitation has grown nearly tenfold, and there is no reason to expect these numbers to diminish or for the pressure to accommodate more snowmobiles to recede. The Park Service's rather casual decision during the 1960s to allow snowmobiles into Yellowstone park has spawned a major industry in West Yellowstone and other adjacent communities, where local business and political leaders have continuously pressed for motorized access, arguing that as a matter of equity snowmobilers are entitled to equal access. But the decision of whether to permit motorized recreation in America's national parks is-and should be-based primarily upon environmental considerations, not equal access or local economic concerns. The Yellowstone region parks cannot accommodate intrusive and polluting motorized activities without impairing the very qualities that make them such special places worthy of extraordinary protection. Even if the issue is framed in recreational (rather than environmental) terms, the only truly equitable resolution is to restrict winter access to snowcoach visitors, which will enable everyone-not just snowmobilers-to enjoy the park as a true natural sanctuary. This conclusion is further buttressed by the overwhelming weight of public opinion, which has strongly supported the original phase-out decision. Indeed, there was no indication during the SEIS scoping process that the public had altered its view that recreational snowmobile use is inappropriate in a national park environment.

To the extent that the snowmobile phase-out decision impacts West Yellowstone and other adjacent communities, that is not an adequate basis to allow this environmentally harmful activity to continue unabated in the region's national parks. Both Yellowstone and Grand Teton parks are part of the Greater Yellowstone Ecosystem, which contains an array of interconnected federal lands that offer an array of recreational opportunities. The responsible federal land management agencies have committed themselves to coordinating their resource management decisions to meet their respective legal mandates. Because there are ample opportunities for recreational snowmobile use on nearby multiple-use national forest lands, the Park Service can-and should-legitimately look to these surrounding public lands to offset the environmental pressures that recreational snowmobiling has generated. Under the original phase-out decision, which would establish an expanded snowcoach system to access the parks, no one will be denied the opportunity to visit the Yellowstone region parks during the winter months. Moreover, the Park Service has no legal or other obligation to support local businesses, let alone to spawn a single industry dependence in gateway communities. In fact, any short term revenue losses experienced by local businesses will be more than offset with the development of a more diverse and less park-dependent winter economy. Even the Draft SEIS acknowledges that the phase-out alternatives would have only negligible economic impacts on the local economy. Draft SEIS, at p. 157. This is not to say that some locally adverse economic impacts may not occur, but these impacts can be mitigated by affording local motorized recreation businesses the opportunity to compete for a permit or license to help operate an expanded winter snowcoach system.

Yellowstone is an icon among our national parks; its resource management policies have long set the standard for the national park system as a whole. After a long and disingenuous history of subordinating park resource protection and scientific management to visitor enjoyment, the Park Service has finally set a new course and committed itself to putting its resource protection responsibilities first. See Richard West Sellars, Preserving Nature in the National Parks: A History (Yale Univ. Press 1997). Congress recently confirmed the important role of scientific resource management in the national parks with its passage of the National Parks Omnibus Management Act of 1998, which is designed "to enhance management and protection of national park resources by providing clear authority and direction for the conduct of scientific study in the National Park System and to use the information gathered for management purposes." Pub. L. 105-391, Sec. 201 (1998). Based upon contemporary scientific information, the Yellowstone region FEIS snowmobile phase-out decision is fully consistent with this statutory policy, and it is therefore an important test of the Park Service's real commitment to utilizing scientific data to meet its resource protection responsibilities.

In sum, I urge you to reaffirm the Yellowstone region snowmobile phase-out decision, to select the Draft SEIS Alternative 1a, and to thus preserve our natural heritage in a truly unimpaired manner for the generations ahead. By demonstrating courage and farsightedness today, the Park Service has the opportunity to ensure a truly worthy national park legacy that can be enjoyed by all Americans as an inspirational winter wonderland. Thank you for considering my views.

Sincerely,

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Date: May 24, 2002

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Subject: Comments on the Winter Use Draft SEIS

Note: I have included a preliminary draft of an implementation proposal for ethical computational modeling, scientific investigation, and reporting of results that bears strongly on the computational modeling, statistical analysis, and reporting of results in the Winter Use Draft SEIS. The comments are also relevant, although late, to the same analysis for the Final SEIS.

The proposal does not spring from a vacuum. The National Research Council, in its report Modeling Mobile-Source Emissions, addresses many of the same concerns, which are applicable to ***all*** computational modeling efforts. Many other experts in the discipline of computational modeling are concerned about the proliferation of models with no documentation of validation, verification, uncertainties or sensitivity analysis.

COMMENTS

Winter Use Draft SEIS Comments
Grand Teton and Yellowstone National Parks
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Pertinent Personal Information

I have been on precisely one snowmobile excursion, more than ten years ago. I went to Yellowstone National Park with some of my family. We borrowed some snow machines, rented others. It was an exhilarating experience. I do not own a snowmobile.

My wife works in the circulation department of a limited circulation specialty magazine publisher. Along with nearly a dozen other magazines, the firm publishes two snowmobile-related magazines. My wife has no specific connection with the circulation of those magazines. We have no financial interests related in any way to the outcome of this decision, and my physical problems probably preclude my ever riding a snowmobile again.

General Questions and Comments

The Winter Use FEIS contains the following statement in **Chapter IV, Environmental Consequences**, on p. 196:

> "An Environmental Impact Statement (EIS) is not a scientific document per se ... It is not necessary to repeat the entire volume of detail on a particular subject, and it is encouraged to cite literature or tier to other analyses ... An EIS is ... meant to provide enough information, both qualitatively and quantitatively, to display the relative differences among the alternatives in subject areas most pertinent ... **scientific integrity of an EIS is demonstrated by disclosing methods of analysis** [emphasis added] ... making explicit references to sources of information ... [CEQ] Regulations allow an EIS to proceed even if there is incomplete or unavailable information, and specifies processes by which to do this ..."

I believe it should be safe to assume that the same ground rules hold for the SEIS. If not, the exception should be prominently noted.

The cautions I have presented in the attached draft dealing with development and use of computational models, statistical analysis, uncertainties, sensitivities, and verification will

enter into my specific comments. Those comments will apply, in many cases, to the FEIS. It may be too late to affect the FEIS directly, but they will strongly indicate that it will be ill-advised to accept any numbers in the FEIS that were generated by computational models, with no confidence intervals or other uncertainty measures, no validation information, and no sensitivity information, as being valid for the kinds of determinations being made.

Specific Comments

Note: In all following quotations, all emphases are present in the original unless otherwise noted.

The EPA **NONROAD** mobile-source emission computational model is cited as one source for emissions numbers. The **NONROAD** model is specifically cited in the Executive Summary (ES) (p. 12) of the year 2000 National Research Council (NRC) report **Modeling Mobile-Source Emissions** (MMSE) with the following limitation:

> "Primarily because of a lack of data, the current off-road-emission model does not accurately estimate off-road emissions inventories ..."

In the ES (pp.9-10), the **PART5** particulate model

> "Is inadequate for supporting the new PM ambient air-quality standards ... Although the results of field studies are conflicting, they indicate that **PART5** does not provide an accurate inventory of emissions."

The Environmental Protection Agency (EPA) **MOBILE** mobile-source emission modeling software series is characterized in the ES (pp. 4-6) as follows:

> Model validation and evaluation have not been addressed adequately by EPA during **MOBILE**'s development. **MOBILE**'s *predictions* of the benefits of air-quality programs [examples of such programs] are often taken as *measurements* of the benefits of these programs. Confidence in the model has been undermined when large discrepancies have been observed between the model's predictions and field measurements. ... *Enhanced model evaluation studies should begin immediately and continue throughout the long-term evolution and development of mobile-source emissions models.* These studies should be done **with oversight and guidance from a reviewing body** [emphasis added] ... Evaluation studies should be conducted to identify and reduce disparities between model-predicted emissions and measured data on emissions and air quality. ... At present the understanding and quantification of the uncertainties in **MOBILE** are inadequate. There are uncertainties in the data used to develop model algorithms, the

statistical analysis of test data, and the model input parameters. All of these lead to large uncertainties in model output. ... *EPA, along with other agencies and industries, should conduct sensitivity and uncertainty analyses of the mobile-source emissions models in the toolkit, especially* ***MOBILE,*** *and explicitly assess the required accuracy for specific applications.* ... Specifically, the analysis should:

• include a rigorous study of the model's sensitivity to all the input data to provide users with information on the most critical factors affecting model results;

• include a rigorous study of uncertainties and bias in all model components and in the data used to develop model parameters and relationships ..."

Questions and comments about use of EPA models:

Were the SEIS investigators aware of the very deep concerns of the NRC regarding the near total inadequacy of the EPA models not having been properly validated or evaluated for their purported purposes and being totally lacking in model uncertainty and sensitivity assessments? The apparent uncritical acceptance of the EPA endorsement of these models bespeaks naivete. If they accepted the models while fully aware of the problems candor and professionalism demand disclosure of the problems. Personally, I believe that professionalism required awareness of the model limitations. All of the information I have presented here is publicly available on federal government web sites, and it took not more than 20 hours to collect all of it, including printout time. That is a small price to pay fro obtaining important relevant background material on the computational models one intends to use in an alleged scientific investigation.

The SEIS, **Chapter IV, Environmental Consequences** (pp175-176) refers to "EPA-approved" air quality models used to estimate ambient concentrations of carbon monoxide (CO) and particulate matter. EPA-approved or not, there is no information about model validation, evaluation, uncertainties or sensitivities. As you can see in the quoted material above, EPA approved the **MOBILE** and **NONROAD** models absent that information. I believe that one may safely infer that EPA approval of a model provides no information about whether this *essential* model information is available or whether the uncertainty, sensitivity, validation, and verification analyses have been performed at all, let alone properly.

A strongly-worded caution is appropriate here. In 2000, the National Academy Press published a report from the National Research Council (NRC) - **Strengthening Science at the U.S. Environmental Protection Agency** - in which the EPA's scientific shortcomings in science are noted. The executive summary mentions criticism over a period of 30 years from sources as varied as the NRC, the EPA's own Science Advisory Board (SAB), the General Accounting Office (GAO) and others, for inadequate scientific practice and performance. Regulatory offices are not required to follow scientific advice

from the EPA's Office of Research and Development (ORD), essentially making the decisions on managerial whim rather than science. There is no "top science official," which " ... is a formula for weak scientific performance in the agency and poor scientific credibility outside the agency ..." There is no official in the EPA with the responsibility and authority for " ... developing processes to ensure that appropriate scientific information is used in decision-making throughout the agency, and ensuring that the scientific and technical information underlying each EPA regulatory decision is valid, appropriately characterized in terms of scientific uncertainty and cross-media issues, and appropriately applied."

In the light of this recent assessment, a statement that technical or scientific work was done by or for the EPA is insufficient justification for acceptance as valid science.

End of questions about EPA models and associated comments

In SEIS **Chapter IV, Environmental Consequences** , Table 77 (pp. 220-221) is titled "Modeled sound impacts for SEIS alternatives compared to selected FEIS alternatives." The only traffic noise model mentioned in Appendix J of the FEIS is the Federal Highway Administration (FHWA) Traffic Noise Model (TNM). The obvious assumption is that the ***FHWA TNM*** model was also used for the SEIS modeling. Otherwise, a significant effort is required to show that results from two separate models are comparable in a meaningful way.

An information memo for the ***FHWA TNM*** dated December 16, 1999 (http://www.fhwa.dot.gov/environment/fhwa_tnm.htm) , refers to the original release of the new ***FHWA TNM,*** which was to have been phased in over the next 24 months, declaring "... the FHWA determined the model was valid and fully acceptable for use."

There are, however, some cautionary notes:

> "However, the verification was limited, i.e., it included three comparisons with point-source geometry and two comparisons of in-situ barrier performance along actual highways."

> "Users ... have been encouraged to do additional validation studies ...but little such work has been reported. Additional validation is necessary to provide increased confidence in the model's results ... Consequently, in support of the FHWA, the Volpe National Transportation Systems Center (Volpe) in Cambridge, MA, has begun a full validation of all aspects of the model. The initial phase of this validation will include the elements of the model most often used in highway traffic noise analyses; validation of all other elements of the model will follow. Field measurements made to support the model validation will be used to begin study of atmospheric effects on the propagation of highway traffic noise ..."

"In addition to the model validation activities, work is also underway to address problems and inconvenience subsequent to the release of the ***FHWA TNM Version 1.0*** ... (...over 200 software bugs and desired GUI enhancements)"

"The model's initial phase validation work and software improvements described above must be completed prior to the final phase-in of the ***FHWA TNM.*** Consequently, the final phase-in date is being extended to **December 31, 2002.**"

Comments on National Park Service (NPS) use of the *FHWA TNM* for traffic noise analysis:

Note the initial phase-in date, roughly March 30, 2000, and the later recommended phase-in date of December 31, 2002. The validation and uncertainty problems coupled with elimination of software bugs and the 21-month delay in phase-in strongly suggest a model that was not adequately debugged and validated at the time it was being used for noise modeling in the FEIS. The problems with the model are not addressed in the SEIS, either. If the TNM was not used for the modeled sound impacts for the SEIS that information deserved a prominent position in this document. If it was, the problems noted above should have been enumerated, with an accompanying statement about uncertainties in the model results.

End of comments on use of *FHWA TNM*

SEIS **Chapter IV Environmental Consequences, (p.223)** states

"Bowlby & Associates conducted A-weighted snowmobile pass-by measurements of several vehicles at different speeds in grand Teton National Park in the winter of 1996. The higher speed data from these measurements (45 to 55 mph) were used to supplement the HMMH measurements to develop a regression line of maximum pass-by level as a function of speed. ... The regression line was used for the snowmobile sound levels in the model for the FEIS. All snowmobiles in the FEIS were modeled at a speed of 40 mph. The regression line crosses [crosses what?] slightly above 73.9 dBA at 40 mph; a rounded level of 74 dBA was therefore used for the modeling of all snowmobiles. The spectrum shape chosen to represent this A-level was one of a 2000 Polaris 500cc snowmobile pass-by at 35 mph (the maximum A-level of this particular pass-by was 72.4 dBA, so the entire spectrum was adjusted up by 1.6 dB [was t "A" left off deliberately or accidentally?] therefore that it would sum to 74 dBA.)"

Questions and comments:

If all snowmobiles were modeled at a speed of 40 mph, why were only higher speed data (45 to 50 mph) used to supplement HMMH measurements? Why not 40 mph and other lower speed data also? Failure to provide justification for this selectivity can only call into question the objectivity and professional credentials of the analyst. Why was the spectrum shape of a 35 mph pass-by adjusted up by "1.6 dB therefore that it would sum to 74 dBA" instead of using a spectrum shape for an actual 40 mph pass-by? This procedure gives the appearance of adjusting real-world measurement to match the model, where honest science demands adjusting the model to match reality. There may be a valid reason for doing so. Failure to provide one automatically invites suspicion of chicanery.

Mention of a regression line in the above quotation gives rise to n additional line of questioning. Any statistically competent regression analysis provides an estimate of regression-associated uncertainty. The document fails to mention that uncertainty. Did the software used for the regression provide it as part of the output? Any reputable statistics software would certainly provide that analysis. Was a spreadsheet-based package used? Did the analyst design his(her) own spreadsheet analysis? No competent statistician (advanced degree in statistics granted by a mathematics or mathematics-oriented statistics department) would dream of offering results of a regression analysis without providing the standard error of the regression.

End of questions and comments on the regression analysis of snowmobile sound levels from pass-by measurements

The **IMPLAN** input-output economic model is named as the model used for estimating socioeconomic effects of the different alternatives.

Comment about IMPLAN validation, verification, assessment:

I was unable to locate information about the validation, verification, or sensitivity assessments of the model. Any time a model is used to generate estimates that will be used as the basis for government decisions, the onus is on the model user to provide reviewers and comment providers with access to complete information about the validation, verification, and assessment of the model, and its associated uncertainties and sensitivities. Unless, of course, the following statement from the SEIS,

> An EIS is ... meant to provide enough information, both qualitatively and quantitatively, to display the relative differences among the alternatives in subject areas most pertinent ... **scientific integrity of an EIS is demonstrated by disclosing methods of analysis** [emphasis added] ... making explicit references to sources of information ...

is only present for window dressing. Which is it?
If the statement is for real, the specified information for IMPLAN should have been made available when the SEIS was made available for comment.

End of comments about IMPLAN

Questions and comments about the near total absence of uncertainties in estimates:

I was able to find only one estimate in the entire SEIS that indicated that any of the contributors had any concept at all about the importance of incorporating uncertainty information in making decisions. There may have been more than one, but confidence intervals or some proxy form were exceedingly sparse in the tables of estimates generated by the models.

No competent scientific decision maker would even consider trying to make a decision in the complete absence of uncertainty information. The one statement that can be made with near certainty is that if one could construct a scenario where a corresponding field observation value were available for each estimated model value, an insignificant fraction of the field measured values would exactly match the model predictions. Use of computational models that are known to be deficient in their representation of the physical phenomena, such as all the EPA model and the ***FHWA TNM***, they are supposed to model, without providing information about the model limitations, and with no uncertainty information on the estimates is extremely difficult to pass off as resulting from unbiased, competent, scientific analyses.

Valid uncertainty analysis might show that the uncertainty intervals about the estimate values of sound levels and air quality indicators contained the acceptable values for those indicators. The direct ***scientific*** implication of that situation is that the estimates are statistically and scientifically indistinguishable from acceptable levels of the indicators.

Use of the raw estimates is scientifically indefensible. Those who disagree are invited to inspect the NRC work dealing with the matter. They are also encouraged to examine **UNCERTAINTY: A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis,** M Granger Morgan and Max Henrion, Cambridge University Press, ISBN-0-521-42744-4.

This SEIS, as presented raises serious questions about competence, ethics, and impartiality of the investigators. It also opens the door for accusations of ideological and political motivation on what should have been a careful scientific investigation. I am grateful that my name is not associated with it.

Alvin J. Nelson, Jr.

Alvin J. Nelson, Jr.

Mandatory Procedures for Ethical Scientific Modeling, Investigation and Reporting

Prologue

Ideally, science has always been about the effort to utilize a transparent, unbiased open process in an attempt to discover "truth" about the universe. Leaving epistemology out of this informal discussion, a review of the history of science reveals that the ideal has been in the past and is today, frequently ignored. Personal beliefs as to the nature of the universe and the "way things ought to be" affect the way many investigators approach scientific investigations - sometimes consciously and sometimes not.

Unfortunately, the nature of the scientific research funding process also provides both motive and opportunity for abuse. "Quid pro quo" peer review processes fail to weed out projects whose design, procedures, and merit are questionable. The need to demonstrate significant research results on the initial phase of a project in order to assure continued funding predisposes toward questionable statistical, data handling, and analytical practices. Comment: The author has, in the course of his project proposal review activities, encountered such practices. He also discovered that unfavorable proposal reviews tend to push project proposers into a process sometimes referred to as "review or opinion shopping."

As one example of questionable behavior on the part of a well-known investigator, consider Dr. Herbert Needleman's refusal to allow access to the (federally funded) database he used in his work on blood lead levels in children. He was found to have excluded from his analysis children who were "lead poisoned" by his definition but had no "impaired intelligence." The federal Office of Research Integrity cited misplotted graph points that were found "difficult to explain as honest error"... according to the New England Journal of Medicine, which had published his original study results.

Regrettably, as in the case of Robert Gallo and the search for the active agent in HIV infections, personal ambition has on occasion led to grave scientific misconduct.

That incident, and many similar incidents in the past few years, have led to efforts to safeguard the scientific modeling and investigative processes against abusive practices on the part of the (we hope) few unscrupulous investigators and modelers whose objectives do not include conduct of rigorous and scrupulous model construction and scientific investigative activities.

Model Development and Modeler Responsibilities

Nearly all scientists will agree that all scientific effort is ultimately directed toward determining "What has happened, what is really happening, what is likely to happen, and how and why," to phrase it informally.

To determine what is happening and what has happened, we depend on observational measurement of "real world" phenomena. To attempt to determine how and why, and to attempt to predict what will happen, we collect data and use it to construct theoretical models. Having constructed a model for a particular physical situation we must then go through a process to certify that it is valid for data sets other than the data set(s) used in its construction. In that certification process, the investigator must investigate model uncertainties and sensitivities.

The initial data collection process involves determination of the "causative" quantities, called independent variables, and the "resulting" quantities, called dependent variables. The following is an oversimplified description of a laboratory-based investigation. In such an environment, the investigator usually controls the values of the independent variables and measures the resulting values of the dependent variables. The relevant independent variables can be tightly controlled, as can the values of (what we believe are) inconsequential or extraneous variables. The investigator may already have a theory as to the nature of the model, but not necessarily. Data are collected in a controlled experimental environment A lengthy process ensues, consisting of subjecting the data to different mathematical and/or statistical processes to determine what model "best" describes the experimental data. .

If the investigator is honest and competent, the final model will never provide an exact match of model output calculated from experimental independent variable input with the actual experimental dependent variable observations. The differences between the model output dependent variable values and the experimentally-obtained dependent variable values are used to estimate statistical model uncertainties.

The true values of the parameters of the model - the physical, chemical, biological, and other constants - can not be known because their values are obtained from measuring devices that are known to be imperfect. They are imprecise and (very slightly) inaccurate. Because the investigator cannot know that the input parameter values are correct, (s)he must - for a competent, ethical and defensible analysis - evaluate the effects of different parameter values on model

output values. The principal determining criteria for choices of different values for model parameters must be the established estimates of bias and imprecision. This phase of the analysis as known as a sensitivity analysis, and frequently requires a statistical experimental design approach for efficient use of resources while providing an adequate assessment of model sensitivities.

Most, if not all, models of real-world phenomena involve describing the behavior of the variables of interest over a specified period of time. Dependent variable values at a specific time are affected by dependent variable values at preceding moments of time. Typically, values at the first time of interest are provided. Subsequent values are calculated at equally-spaced time intervals over the time period of interest. The spacing of the time intervals is called the "time step." The dependent variable values are usually affected by the value of the time step. Such models are called "time-dependent."

One may calculate model output values for a time-dependent model over the same time period using different values for the time For example, one could make two different runs of a model changing only the time step value. The time step for the first run can be specified as ten times the value of the time step for the second run. Every tenth time step on the second run you will get values that should correspond to a specific time step on the first run. The output values should be essentially the same for a "time-step robust" model. There are real-world models that are not time-step robust. You can't always tell by looking at the model equations, so it may be important to do a time-step sensitivity analysis. The decision not to perform such an analysis must be justified on rigorous technical grounds.

The model certification process must also include prediction of not already available results from at least one additional set, and many more additional sets if possible, of experimentally derived independent-dependent variable data sets **that have not been used in the derivation of the model nor used to refine the model.**

After all data have been collected, and before **any** analysis is performed, the data should be placed in a secure, tamper-proof archive facility. Data paid for, in whole or in part, with taxpayer funds must be made freely available on the internet. A complete text description of the data collection and/or experimental process must accompany the data. Results from any follow-on data collection must also be similarly archived. The advantage of this arrangement is that it makes the model developer more readily accountable, since any interested party can analyze the same data set. The research process will therefore be open to public scrutiny and will therefore be less likely to be ideologically or politically influenced because of the open process.

The above description must be modified for scientific data that are not obtained under carefully controlled laboratory conditions. Unfortunately, most scientific data come from measurements made outside the laboratory. The investigator is not free to choose the values for the independent variables or to control the influence of (what (s)he believes to be) inconsequential or extraneous variables. This lack of control increases uncertainties associated with model output and places additional responsibilities on the investigator.

The model development steps are essentially the same as in the controlled laboratory environment scenario, but the additional uncertainty sources must be explicitly accounted for.

Investigator Responsibilities

A scientific investigator has several areas of responsibility in the conduct of an ethically and scientifically sound investigation.

Nearly all scientific investigations involve the use of mathematical or statistical computational models and of some kind data or estimated values used as input for the models.

With the advent of extremely fast and powerful personal computers at prices that make them widely available, anyone with the cash for a computer - qualified or not - can put together a computational model of any phenomenon (s)he chooses. The onus is therefore on the scientific investigator to verify and certify that the computational model(s) (s)he uses have been properly developed, validated, and verified, with complete information on model uncertainties and sensitivities.

In the near future one would hope that the archived data set used for the development of the model would also be referenced by website address.

The investigative report must contain a complete description of the computational model(s) used. The description must include the name of the model and the source of the model if it is obtained from an outside source.

The reports must contain tabulated input values, by model, for all models used. Tabulated input data should be provided in electronically accessible format that can be read directly as input by the computational models used. All uncertainty and sensitivity analysis details must also be included. This requirement will dissuade ideologically or politically biased manipulations because it will facilitate second-party oversight and audit activities. Investigators will be forced to defend unusual data selection and analytical practices. Lack of uncertainty and sensitivity information must be defended. Use of models that do not provide such information must also be defended on technical grounds.

The final report of results must incorporate an analysis and assessment of uncertainties and sensitivities and their effects, if any, on the conclusions of the investigation. Assertion that uncertainties and sensitivities do not affect the conclusions of the investigation require detailed justification.

Alvin J. Nelson, Jr.

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Public Comment Letter on Winter Use SEIS for Yellowstone
Focusing on Snowmobile Impact on Wildlife

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May 24, 2002

This is a letter in favor of implementing what is called Option 1b in the Supplemental Environmental Impact Statement (SEIS) for the Winter Use Plan for Yellowstone National Park. In this letter I focus mainly on the impact of snowmobiles on wildlife in the park. Indeed, given the importance of wildlife in the constellation of Yellowstone's natural resources, as something essential both to most people's enjoyment of the park, and to the functioning of the park's ecosystem as a whole, the impact of winter recreation on wildlife in particular should not be overlooked.

I divide this letter into three main sections. In the first section, I ask the question of whether the National Park Service (NPS) is obligated to take the health and interests of wildlife into account when formulating a winter use plan for Yellowstone. The answer to this question may seem obvious, and in many ways it is. But given the disproportionate attention given in the impact statement to what are essentially various aspects of the human visitor's experience in the park, I feel it is important to get clear on exactly why, how much, and in what way *wildlife* matters to the winter use plan. In the second section of this letter, I ask the question of whether winter recreation in the park, and particularly the use of snowmobiles, does in fact impact the health and interests of park wildlife. In the third section I suggest which of the four alternatives presented in the SEIS is preferable, given the conclusions that I reach in the first two sections. Finally, I conclude by offering some reflections on what the Yellowstone snowmobile controversy has to teach us about our changing views toward wildlife and to the natural world in general.

Does the NPS have the authority to protect wildlife from harm? And, if they have this authority, how far does it extend and when are they obligated to use it? In the first instance, it is clear that the NPS does have the authority to protect wildlife from harm. For the simple purposes of this brief letter, we can isolate three main sources of the mandate of the NPS: acts of Congress, executive orders, and inter-agency directives. The Organic Act of 1916 established the NPS, and directed it to, "conserve the scenery and the natural and historic objects and the wildlife [of the national parks]."[1] The General Authorities Act of 1978 upheld the original mandate, and strengthened it with respect to the ability of the NPS to regulate human activity in the parks, saying, "the authorization of activities shall be construed ... in light of the high public value and integrity of the National Park System, and shall not be exercised in derogation of the values and purposes for which these various areas have been established."[2] As I have already noted, the "values and purposes" of the NPS consist in no small part, *vis* the Organic Act, in the protection of native wildlife.

Second, the NPS has from time to time received important direction in the form of an order by the President. In an executive order of 1972, President Nixon told the NPS that, "areas and trails shall be located to minimize harassment of wildlife or significant disruption of wildlife habitat."[3] In 1978, President Carter further ordered that, "considerable adverse effects on the soil, vegetation, wildlife, [or] wildlife habitat" should lead to the closure of trails or areas to such vehicles as were responsible for the effects.[4] Of course, terms such as "resources and values," "harassment," significant disruption," and "adverse effects," need significant clarification before they can present themselves as real guides to action. And the NPS itself has committed significant resources to fleshing out just what the necessarily broad directives of the higher powers of government mean for the everyday management of the parks. According to the NPS

2001 Guide to Management Policies, "when there is a conflict between conserving resources and values and providing for the enjoyment of them, conservation is to be predominant."[5] Later, the guide states unequivocally that, "the Park Service must leave park resources and values unimpaired," among which it lists the parks' "wildlife, and processes and conditions that sustain them."[6]

Clearly, then, the NPS does indeed have the authority to take the health and interests of wildlife into account when formulating policy. In fact, given the mandate of the NPS to preserve the natural conditions and wildlife of the park, the health of Yellowstone's wildlife can be argued to have intrinsic importance, independent of its value for park visitors. But it is also important to realize that visitor enjoyment is also an important part of the mandate of the NPS. Indeed, insofar as the prerogatives of visitor enjoyment can be seen to overlap with those of wildlife preservation, looking after the interests of wildlife becomes that much more vital. And in fact this overlap is significant. According to a 1995 survey conducted by the NPS, 93 percent of visitors to Yellowstone rated wildlife as "very important" or "extremely important."[7] And in its section on "social values," the SEIS states that, "in general, visitors would like mechanized access into Yellowstone in the winter ... however, when faced with a specific choice (for example, help protect bison versus mechanized access) it appears that a majority of the public is willing to accept major changes in access policy."[8]

Thus, when considered from several different angles, it appears that the NPS does indeed have both the authority in general, and specific reasons in the case of Yellowstone, to take the interests of wildlife into account when formulating policy. Our first question is answered – in the affirmative. We can now move on to our second question, namely, whether the health and interests of wildlife are in fact being jeopardized by winter recreation in Yellowstone, and specifically by snowmobiles. When considering the impact of snowmobiles on wildlife, it will be helpful to distinguish between populations of a given species, say, elk, and individuals of that species. For we will see two things. First, we will see that while the impact of snowmobiles and other forms of winter recreation on populations is ambiguous, the impact on individuals is not. And second, we will see that, given the special mandate of the NPS, the potential for impact on populations is sufficiently real, and the documented impact on individuals is sufficiently serious, to merit action from the NPS.

The SEIS observes four main categories of snowmobile impact on wildlife: 1) mortality and injury due to collision, 2) harassment and displacement, 3) stress, and, 4) energy costs. We will consider each of these in turn. The first way that snowmobiles impact wildlife is through the simple fact that motorized vehicles are prone to mutually disastrous collisions with animals. From 1995-2001, between December and March of each year, emergency medical services were called out 154 times to service snowmobile-related incidents – 62 percent of the total number of incidents during that time period. Of the snowmobile-related motor vehicle accident reports filed by park rangers during the period, 5 percent of those citing a reason cited a bison in the road as the cause of the accident. All told, rangers issued 1386 citations to snowmobile drivers during these six years, for such things as speeding, off-road travel, and failure to drive safely.

In its summary of the impact of snowmobiles on elk and bison, the SEIS describes "mortality caused by collisions" as "adverse, [but] none to negligible and short term."[9] This is surely true with respect to populations. But while snowmobile collisions do not

cause significant harm to populations, it must be admitted that the effect of a collision on the individual animal collided with could hardly be more severe. There can be no more adverse or long-lasting impact than death.

Regarding the second kind of impact cited in the SEIS, "harassment and displacement from preferred habitats," it would appear that the scientific jury is still out as far as populations are concerned. *Effects of Winter Recreation on Wildlife in the Greater Yellowstone Area: A Literature Review and Assessment*, a report put out by two groups closely associated with the NPS, contains many interesting hypotheses on how human activity, and particularly motorized activity, may impact wildlife. Elk and other Yellowstone herbivores are attracted during the winter to places of low snow-cover, like geothermal areas and stream banks. Unfortunately, these are also the places most attractive to tourists, and most likely to be visited by off-roading snowmobiles. Elk and other park ungulates lead a fragile existence during the wintertime, and being able to access the best habitat is vital to their survival. *Effects of Winter* cites a 1975 study that tells how, "when recreational snowmobile activity increased in the Bridge Creek Game Management Area in Oregon, winter elk counts declined by 50 percent."[10] The authors of the study hypothesize that this may have been because the snowmobiles harassed the elk, and displaced them from the best habitat. *Effects of Winter* suggests that, "elk will readily desert productive habitats when disturbance is excessive."[11]

One could of course reply by noting that the SEIS estimates the impact of snowmobiles on wildlife with respect to harassment and displacement to be "adverse, [but] negligible to minor and short term."[12] This conclusion accords fully with the tentative tone of many of the essays in *Effects of Winter*: there is just a great deal we do not know. Still, even if the Yellowstone elk population as a whole is not at risk, it seems clear that the displacing effects of snowmobiles are likely to cause the suffering and death of at least some elk, not to mention bison and other wildlife, every winter. Yellowstone's foragers, both the EISs and their supporting documents make clear, do in fact lead an exceedingly fragile winter existence. Up to 87 percent of the daily forage consumed by an elk in winter is used for standard metabolic function, leaving less than 15 percent for growth, reproduction, temperature regulation, and activity.[13] During especially severe winters, elk are extremely vulnerable to the fluctuations of fate, and having to deal every day with hundreds of noisy, smelly snowmobiles is not likely to ease their pain.

And so we face here the same dichotomy between populations and individuals as we saw in the previous section on collision mortality. To wit: populations are *probably not* at risk from snowmobile harassment, but individuals *definitely are*. Indeed, this interesting and revealing dichotomy occurs in the third and fourth possible ways that winter recreation can effect park wildlife, as well. For as far as stress is concerned, there is unambiguous evidence that snowmobile activity causes significant amounts of stress, as measured in levels of the hormone fecal glucocorticoid (FGC) in wolves, bison, and elk. According to the SEIS, "higher FGC levels were found in wolves in areas and times of heavy snowmobile use, and for the elk, day-to-day variations in FGC levels paralleled the number of snowmobiles, i.e. higher numbers of snowmobiles produced higher stress levels."[14] This is a powerful and direct correlation between a specific form of winter recreation, and its effect on the wildlife whose territory it makes use of.

So what are the specific *effects* of high stress levels on wildlife? On the population level at least they do not seem to be significant. As the SEIS acknowledges,

"despite the potential for deleterious effects, elk population in the Madison River drainage [in the area where the FGC study was performed] appears to be stable and increasing at this time."[15] And the SEIS concludes: "oversnow motorized access to the parks does not appear to be resulting in long term effects to populations of elk and bison."[16]

But the SEIS also goes on to say, "nonetheless, harassment and displacement of *individuals* is evident, and remains a stated concern."[17] And this is important. For how much death, injury, harassment, displacement, stress, and, in the last instance, energy loss, should we be willing to accept in *individual* animals? And how much should the NPS be expected to tolerate, given its special mandate to conserve wildlife, and even to make conservation "predominant … where there is a conflict between conserving resources and enjoying them"?[18]

In my view, not much. For surely it is not the mission of the NPS to determine the maximum amount of stress and harassment that a winter population can sustain, the maximum amount of collateral damage, and then to allow recreation up to that point. Rather, the clearly stated mission of the NPS to encourage knowledge about, respect for, and perhaps even identification with, the natural world. This mission, which is as much about public values as it is about natural resources, is incompatible with a form of recreation which clearly, according to the best science available, makes winter life for many animals much harder than it has to be. Industry advocates point to the fact that snowmobiles are apparently not causing a decline in populations of elk and bison. But we have seen that the NPS, in order to regulate park use, does not have to show that snowmobiles are causing irreversible damage to the park ecosystem. Rather, the NPS simply has to show that snowmobiles are causing significantly more damage, harassment, and stress to animals than is necessary, given the range of recreation options that are open to the public.

And in fact, there is a good way both to minimize harm to wildlife, and to ensure the continued enjoyment of the park for ourselves and future generations. That way is Option 1b of the SEIS, which represents a more gradual phase-in of the original FEIS's Plan G. Option 1b will ban snowmobiles from the park by 2005, but allow snowcoach travel to ferry visitors about the park. No other forms of recreation will be affected. Thus, park visitors will still be able to enjoy the park, its wildlife and scenery, while at the same time wildlife will be freed from a major disturbance. This disturbance, as we have seen, though apparently not population-threatening, is certainly disruptive enough to merit non-toleration, so long as other, less intrusive ways of enjoying the park remain available.

It would not spell the end of Yellowstone, were a different option to be adopted from the SEIS than the one I have suggested, and snowmobiles allowed to stay. The presence of snowmobiles would continue to cause elk and bison, among others, much discomfort and stress, and probably deliver not a few to an early death, but park wildlife as a whole would almost certainly survive. But would this really be something that we could feel good about? Our National Parks are supposed to be special places – refuges not just for wildlife, but for the human spirit; places where we might have the opportunity to think about and relate to the natural world much differently than we normally do. In a National Park, if nowhere else, humans and animals are on an equal footing, and deserving of equal respect. Narrowly construed, the Organic Act's directive to "conserve

the scenery and the natural and historic objects and the wildlife [in the National Parks]," might be interpreted simply to mean that populations are to be kept from declining. But the spirit of the law is much different. The spirit of the law is much closer to what A.S. Leopold meant when he wrote, in a report to the Secretary of the Interior in 1963, that "a national park should represent a vignette of primitive America."[19] Snowmobiles are not primitive. They are transparently, obnoxiously modern. And Yellowstone's wildlife deserves better.

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1 SEIS, p.5
2 SEIS, p.5
3 SEIS, p.7
4 SEIS, p.7
5 SEIS, p.8
6 SEIS, p.9
7 Greater Yellowstone Working Group, *Effects of Winter Recreation on Wildlife of the Greater Yellowstone Area: A Literature Review and Assessment* (October, 1999): p.1; hereafter, EWR.
8 SEIS, p.98
9 SEIS, p.214
10 EWR, p.23
11 EWR, p.22
12 SEIS, p.214
13 EWR, p.21
14 SEIS, p.124
15 SEIS, p.126
16 SEIS, p.126
17 SEIS, p.126
18 SEIS, p.8, as previously noted.
19 A.S. Leopold et al., *Wildlife Management in the National Parks*, 1963: p.4.

Secretary Gale Norton
Department of the Interior
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October 17, 2001

Dear Secretary Norton:

In 1916, the United States Congress demonstrated considerable foresight in establishing the National Park Service (NPS). In so doing, Congress established a unique classification of lands to be managed in essentially a natural condition -- where the preservation of nature takes precedence. Thus, Congress declared that the mission of the NPS is to "conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same [so as to] leave them *unimpaired* for the enjoyment of future generations." 16 U.S.C. §1 (emphasis added).

To protect national park wildlife and other values, Congress has consistently reaffirmed the core mission contained in the NPS Organic Act that activities within our national parks "shall not be exercised in derogation of the values and purposes for which these various areas have been established." 16 U.S.C. §1a-1.

Presidents also underscored the obligation to protect national parks and other publicly-owned lands when off-road vehicles began causing increasing damage in the 1970s. Presidents Nixon and Carter issued Executive Orders to control and limit ORV use "to minimize harassment of wildlife or significant disruption of wildlife habitats," and to provide land managers with the authority to prohibit ORV use when necessary to protect natural values. (E.O. 11644, as amended by E.O. 11989). ORV use and adverse impacts of such use on our publicly-owned lands, however, have continued to escalate.

In recent years, the impact of snowmobiles within our national parks has come under increased scrutiny. National Park Service regulations prohibit snowmobiling except where designated and "only when their use is consistent with the park's natural, cultural, scenic and aesthetic values, safety considerations, park management objectives, and *will not disturb wildlife* or damage park resources," 36 C.F.R. §2.18(c) (emphasis added).

In late 2000, the NPS published a final Environmental Impact Statement (EIS) and Record of Decision (ROD) which demonstrated the necessity of phasing out snowmobile use in order to uphold laws and protect Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway. The EIS was the product of over ten years of analysis and substantial public involvement. Most importantly, the conclusions drawn in the EIS and ROD were based on substantial, credible, and the best available scientific evidence documenting the adverse impact of snowmobiles on wildlife, air quality, natural quiet and other park values. The Environmental Protection Agency observed that the EIS "includes among the most thorough and substantial science base" ever seen in a planning document. (EPA Comments to NPS on the draft EIS, December 1999).

Based on the scientific evidence, it is our professional opinion that snowmobiling results in significant direct, indirect, and cumulative impacts on wildlife, their behavior and environment. As documented in the scientific literature and the Park Service's EIS and ROD, impacts to wildlife include harassment, displacement from important or critical habitats, disruption of feeding activities, alteration in habitat use and distribution patterns, and depletion of critical energy supplies in individual animals potentially resulting in increased mortality or reduced productivity. Such impacts are magnified in the severe winter climate of the Greater Yellowstone Ecosystem where energy is a critical factor in determining survival.

Given the nature preservation mandate of the NPS, the harassment, degradation, and disruption of park wildlife attributable to snowmobiling clearly violate the NPS impairment standard. Ignoring this information would not be consistent with the original vision intended to keep our national parks unimpaired for future generations.

Sincerely,

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